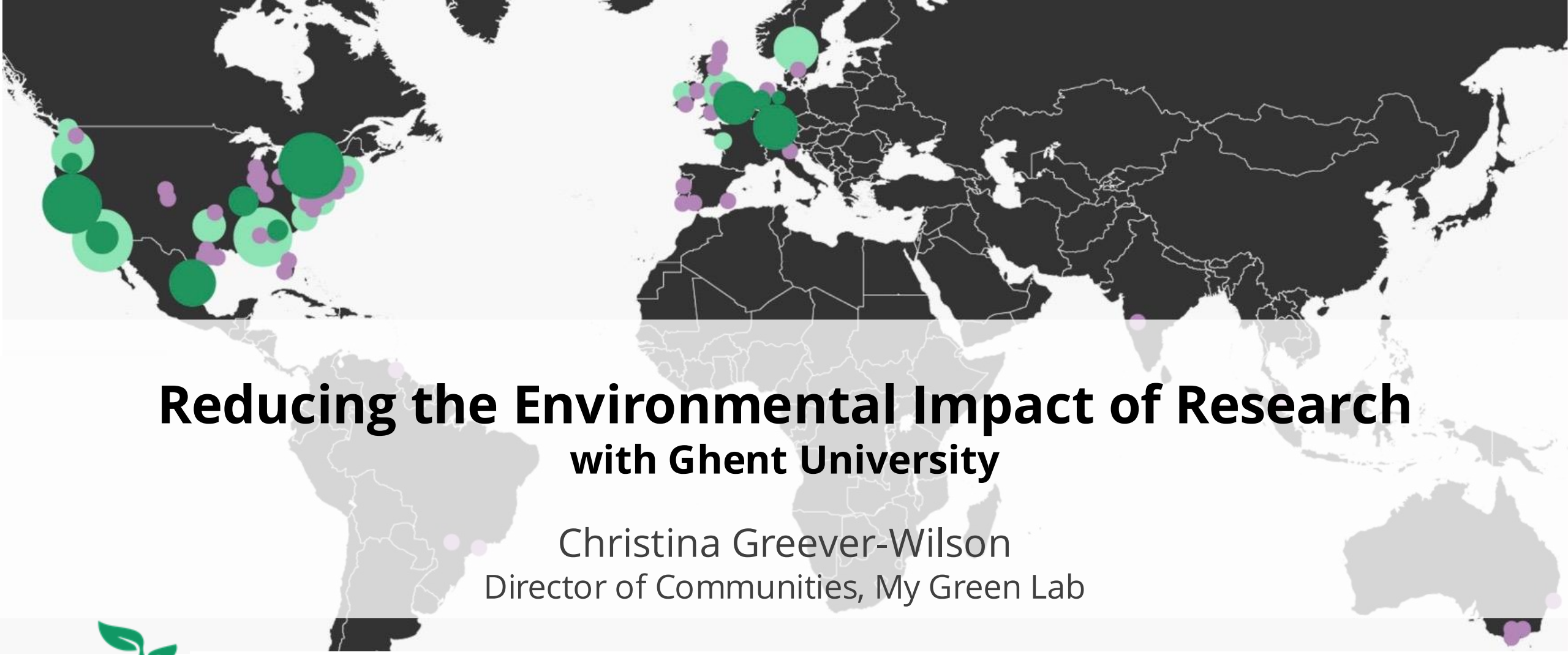


Reducing the Environmental Impact of Research

with Ghent University

Christina Greever-Wilson
Director of Communities, My Green Lab

my green lab.

Building a global culture of sustainability in science

Sustainability: “meeting the needs of the present without compromising the ability of future generations to meet their own needs.”

- UN Brundtland Commission, 1987

Sustainability: “meeting the needs of the present without compromising the ability of future generations to meet their own needs.”

- UN Brundtland Commission, 1987

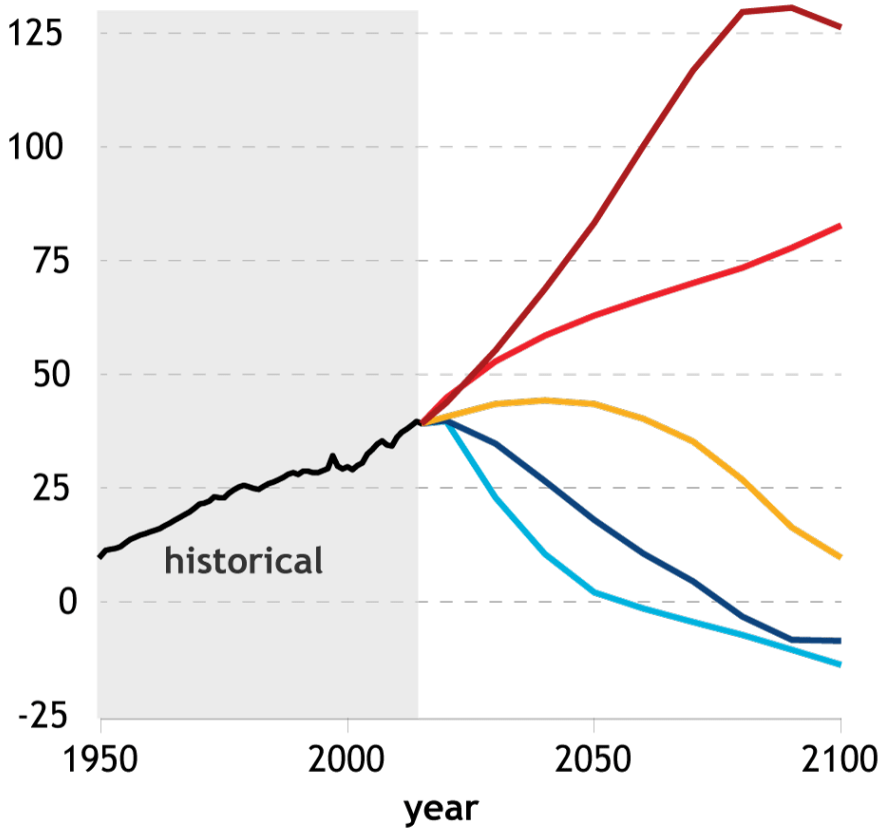
Photo by J V on Unsplash

Photo by Jan Canty on Unsplash

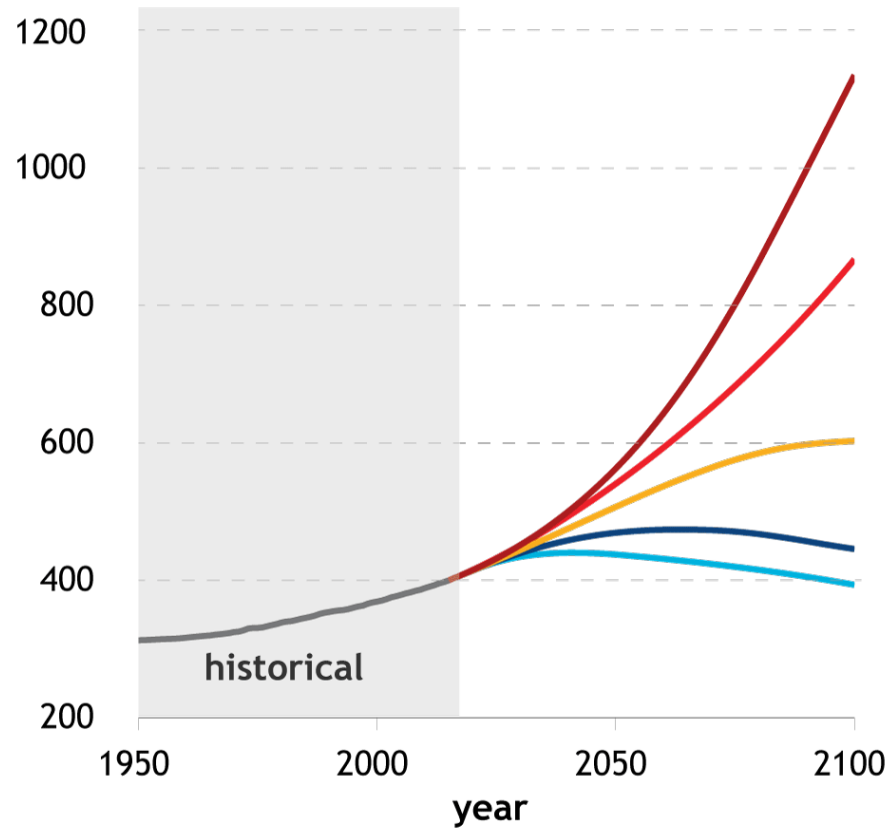
Photo by Olivier Mary on Unsplash

my green lab.

Past and future carbon dioxide emissions
(billions of tons/year)



Past and future atmospheric carbon dioxide
(parts per million)



Socioeconomic pathways

very high emissions → *very low emissions*

SSP5-8.5 SSP3-7.0 SSP2-4.5 SSP1-2.6 SSP1-1.9

NOAA Climate.gov, adapted from IPCC AR6 Technical Summary, Figure TS.4

United Nations Race to Zero

12,480 BUSINESSES

1,208 UNIVERSITIES

1,139 CITIES

48 STATES & REGIONS

691 FINANCIAL

84 HEALTHCARE

my green lab.

Problem

Laboratories are some of the **most resource intensive buildings** of any kind.

10x

More than office energy spaces

4x

More water than office spaces

5.5mil

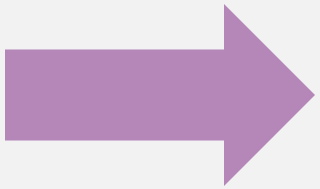
Metric tons of plastic waste each year

(2% of global plastic waste)

The Biotech and Pharma industry has a **massive and growing carbon footprint**.

260mil

Metric Tons CO_2e Annually



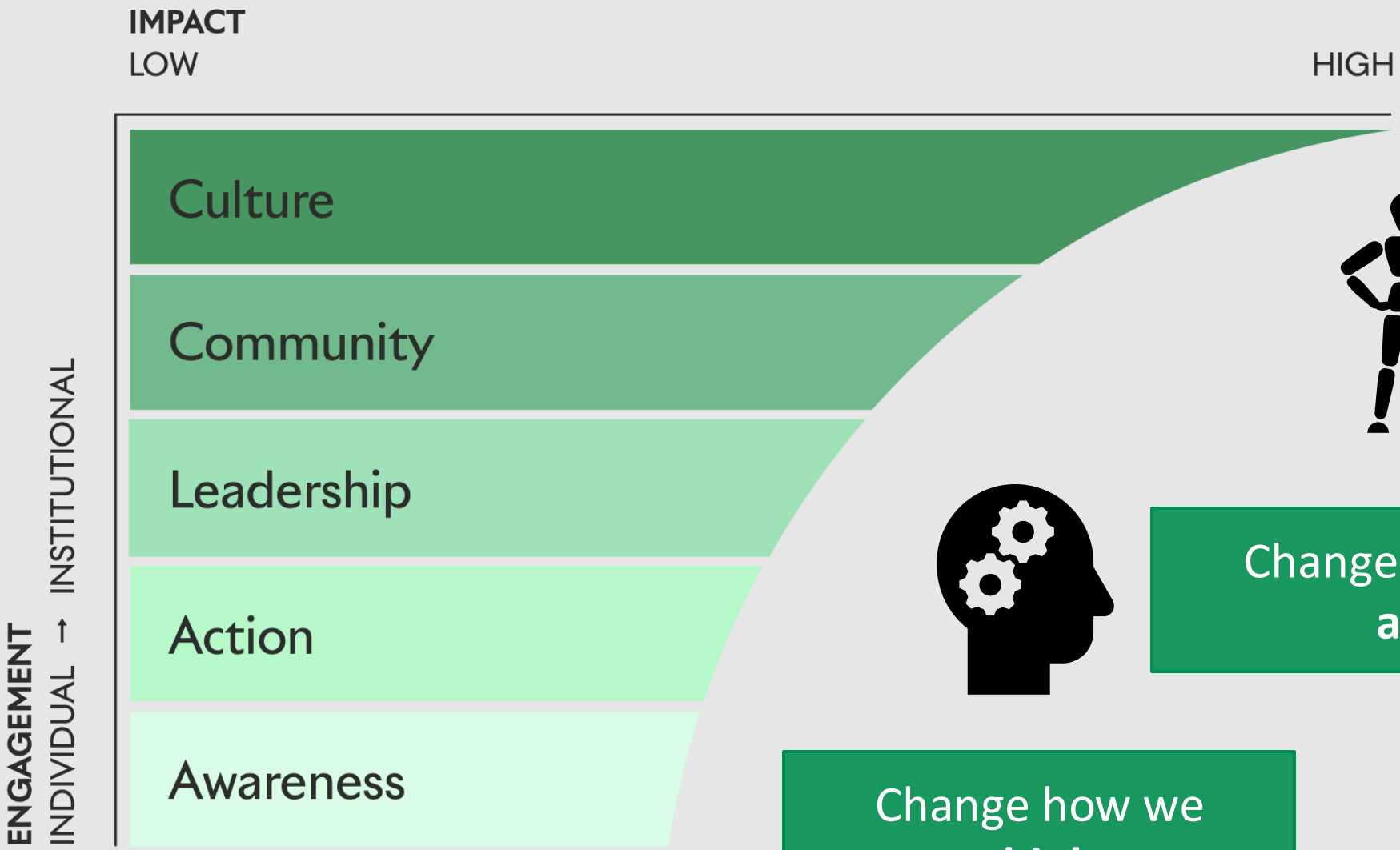
Equivalent to

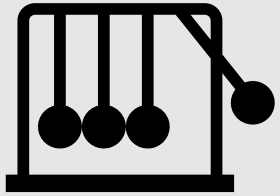
578

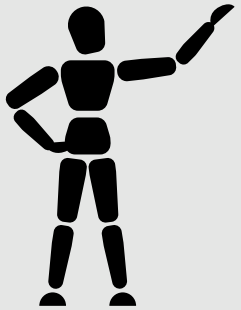
Natural Gas Fired Power Plants

my green lab.

My Green Lab's Theory of Change







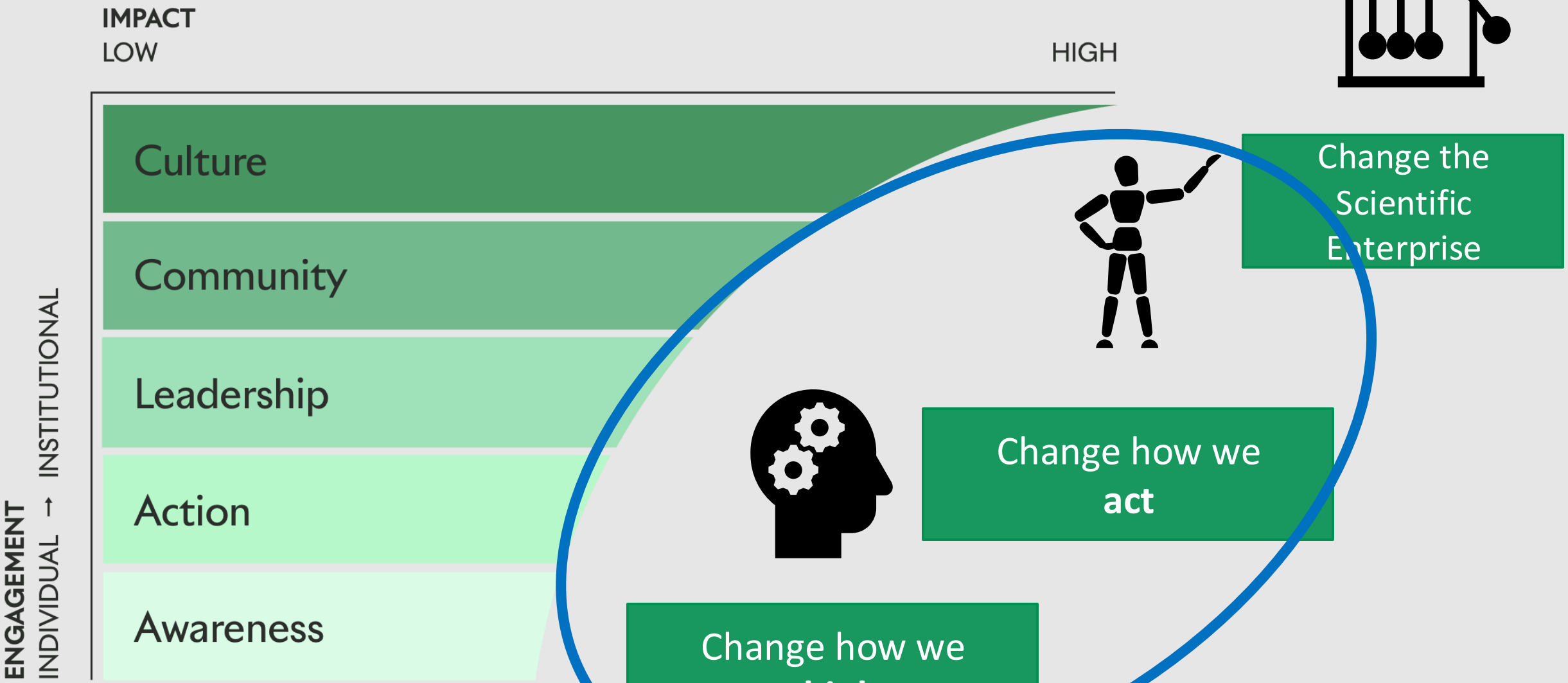
Change the Scientific Enterprise

Change how we **act**

Change how we **think**

my green lab.

My Green Lab's Theory of Change



my green lab.

Where To Start?

ashleybatz.com

my green lab.

Photo by Paola Aguilar on Unsplash

Why?
What if?
How might I?

Allison Paradise
Founder of
My Green Lab

my green lab.

Choose Awesome !

- Interrogate your behavior
- Don’t be afraid to try something different, or pilot new ideas
- Find solutions that you can sustain
- Focus on where your lab uses the most resources first

my green lab.

Embracing Sustainability Should Never Negatively Impact Your Science or Processes

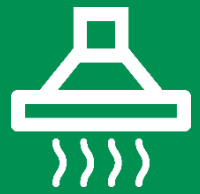
my green lab.

Creating Your Own Change

my green lab.

Areas of Influence

Plug Load



Fume Hoods

Green Chemistry

Cold Storage

Resource Management

Water

Recycling & Waste Reduction

Purchasing

my green lab.

Waste Reduction

Laboratories are constantly changing

In The Past

Multi-Endless Wash & Reuse

Today

Single Use & Discard

Ref: Grenova

my green lab.

Waste Hierarchy

Prevent – Top priority is preventing waste. Can waste be avoided by not using the material in the first place?

Reduce – Can less materials be used in the design and manufacturing stage? How about using one of something instead of four ?

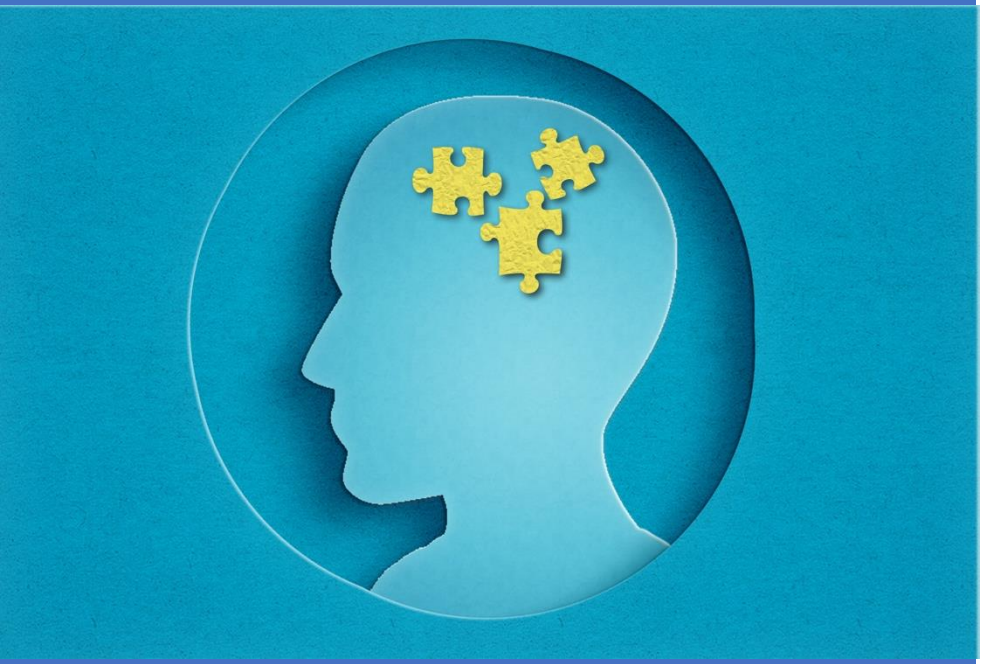
Reuse – Can materials be re-used in other areas or by someone else? Washed and re-used?

Recycle – Can the materials be recycled, either in whole or in part to turn the waste into a new product

Recover – Where further recycling is not practical or possible, energy or materials could be recovered from waste through processes such as anaerobic digestion or incineration

Dispose – Least favourable options is recovered for energy, landfilled or incinerated (without energy recovery).

What can you do?



The 3 biggest contributors to the plastic waste in laboratories are:

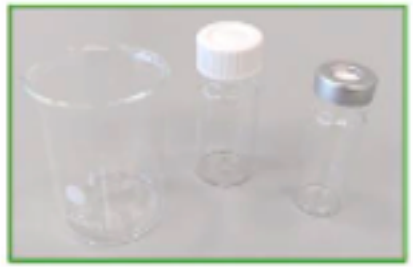
1. Syringes and pipet tips
2. Personal protective equipment (e.g. gloves)
3. Sample storage containers (e.g. tubes)

Univ. of Groningen Green Labs RUG Guide

Prevent

- Eliminate single-use lab plastics whenever feasible. Consider the use of glass or metal reusable products instead of single-use plastics (e.g. replace plastic petri dishes with glass petri dishes, plastic Pasteur pipettes to glass)
- Enact policies that prevent the shipping of expanded polystyrene to your institution, if possible
- Weigh the chemicals directly into the reaction flask or replace plastic weighing boats with weighing paper
- Only order what the lab needs!

Falcon tubes for solutions that do not need centrifugation



Reference: A guidebook for sustainability in laboratories

Reduce

Consider your Protocol

- Whenever you can, reduce number of experiments to achieve your goal / better design
- Right – sizing vessels and tubes (Smallest possible)
- Do all steps need to be sterile if you sterilize the end-product in an autoclave?

Avoid Obsolescence

- Share equipment with other labs if you don't need it anymore
- Share reagents and consumables that will expire

Embrace Sustainable Strategies

- Products with less packaging or plastic
- Buy in bulk
- Consolidate vendor orders

Reuse

Lab materials made of heavy-duty plastic that might be candidates for sterilization / reuse:

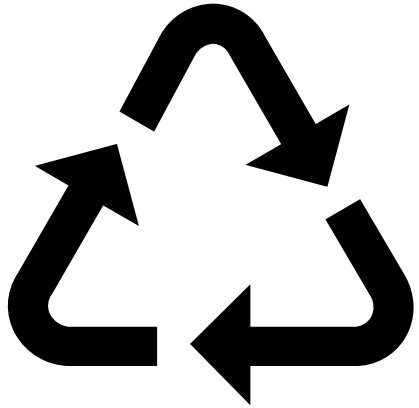
- Conical tubes
- Centrifuge tubes
- Cryogenic Vials
- 96- Well plates
- Weigh boats
- Cell culture plates
- Pipette tip boxes
- Pipette tips

Styrofoam coolers & ice packs >> use for shipping

Recycle

- Participate in vendor take-back or recycling programs, especially if they embrace Extended Producer Responsibility

- Common lab materials organizations try to divert from landfill/incineration:
  - White block foam
  - Pipette tip boxes
  - Solvents & metal solvent drums
  - Gloves
  - Lab Glass (like brown chemical bottles)
  - Plastic Film



This does NOT mean its able to be recycled !

Panic! Its getting a bit too much

Rethink / Redesign / Prevent

Upstream

- Choose supplies and chemicals with reduced environmental impact, plastic content and/or packaging

In The Lab

- Look at your processes, can you eliminate, reduce or reuse any of the supplies

Downstream

- Is it possible to increase recycling or use take-back schemes ? What about promoting re-use?

Panic! Its getting a bit too much

Rethink / Redesign / Prevent

Upstream

- Choose supplies and chemicals with reduced environmental impact, plastic content and/or packaging

In The Lab

- Look at your processes, can you eliminate, reduce or reuse any of the supplies

Downstream

- Is it possible to increase recycling or use take-back schemes ? What about promoting re-use?

Resource Management

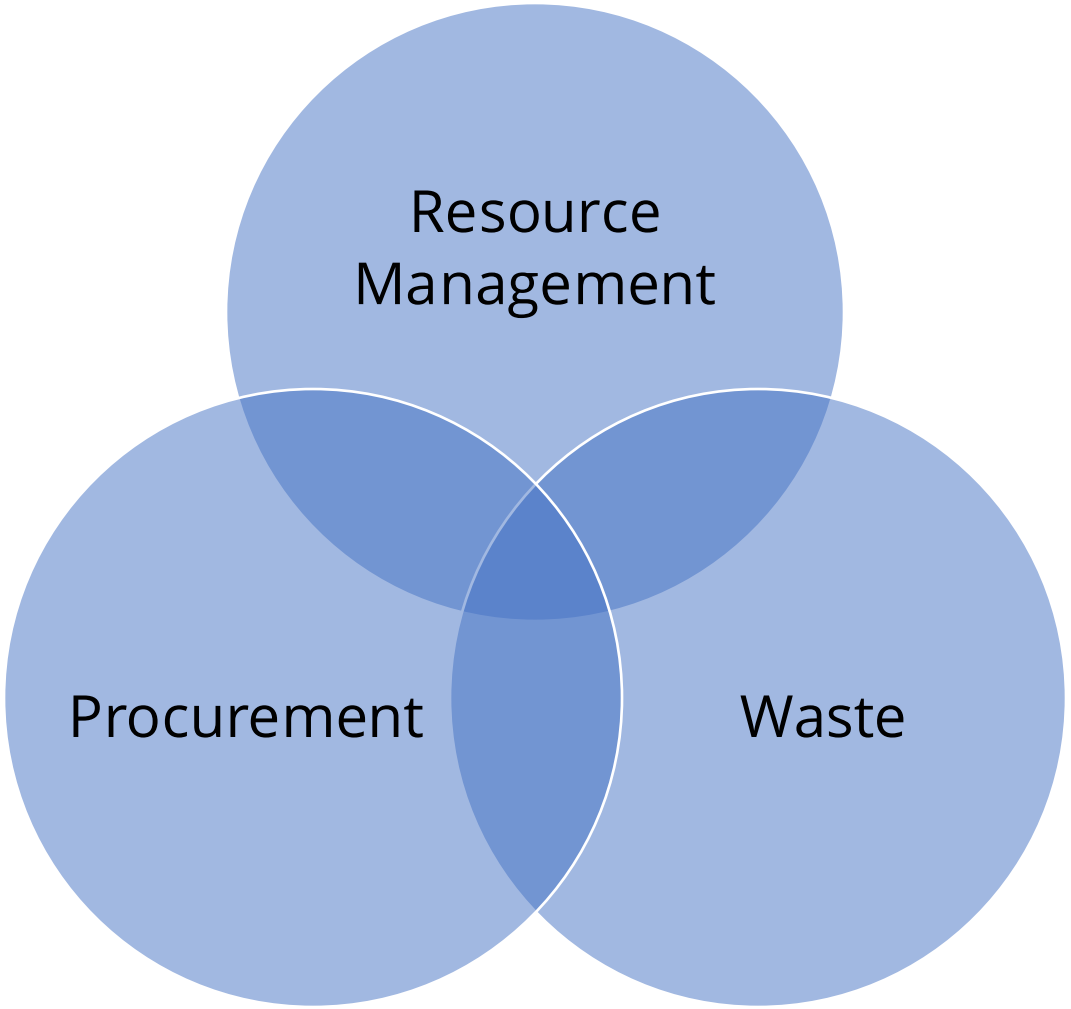
Once you bring materials into the lab it's imperative that they are used efficiently and discarded correctly !

Do you know what resources your lab has? >>

This will impact purchasing!

What is your lab's process for managing the reagents, consumable supplies, and equipment?

Everything is connected!



Resource Management

- Accurate inventories
- Right-sizing purchases
- First in / first out

Dana-Farber / Harvard Cancer Center: https://www.dfhcc.harvard.edu/research/core-facilities/cancer-proteomics/

my green lab.

Additional Actions

- Consider implementing an inventory management system or use the one provided by your institution
- Establish an efficient process for checking the inventory before purchases are made. This will prevent unnecessary over purchasing and save the lab money while also cutting down on waste. Make sure that everyone in the lab is aware of this process.

- If there are any chemicals or reagents that frequently are thrown out unused, then consider buying less of these materials
- If your lab no longer needs something, see if a neighboring lab could make use of it (before the material expires on your lab's shelf!)
- Maintain gas lines and regularly check for leaks. Consider scheduling regular checks on your own or work with your facilities department to get regular maintenance.

Panic! Its getting a bit too much

Rethink / Redesign / Prevent

Upstream

- Choose supplies and chemicals with reduced environmental impact, plastic content and/or packaging

In The Lab

- Look at your processes, can you eliminate, reduce or reuse any of the supplies

Downstream

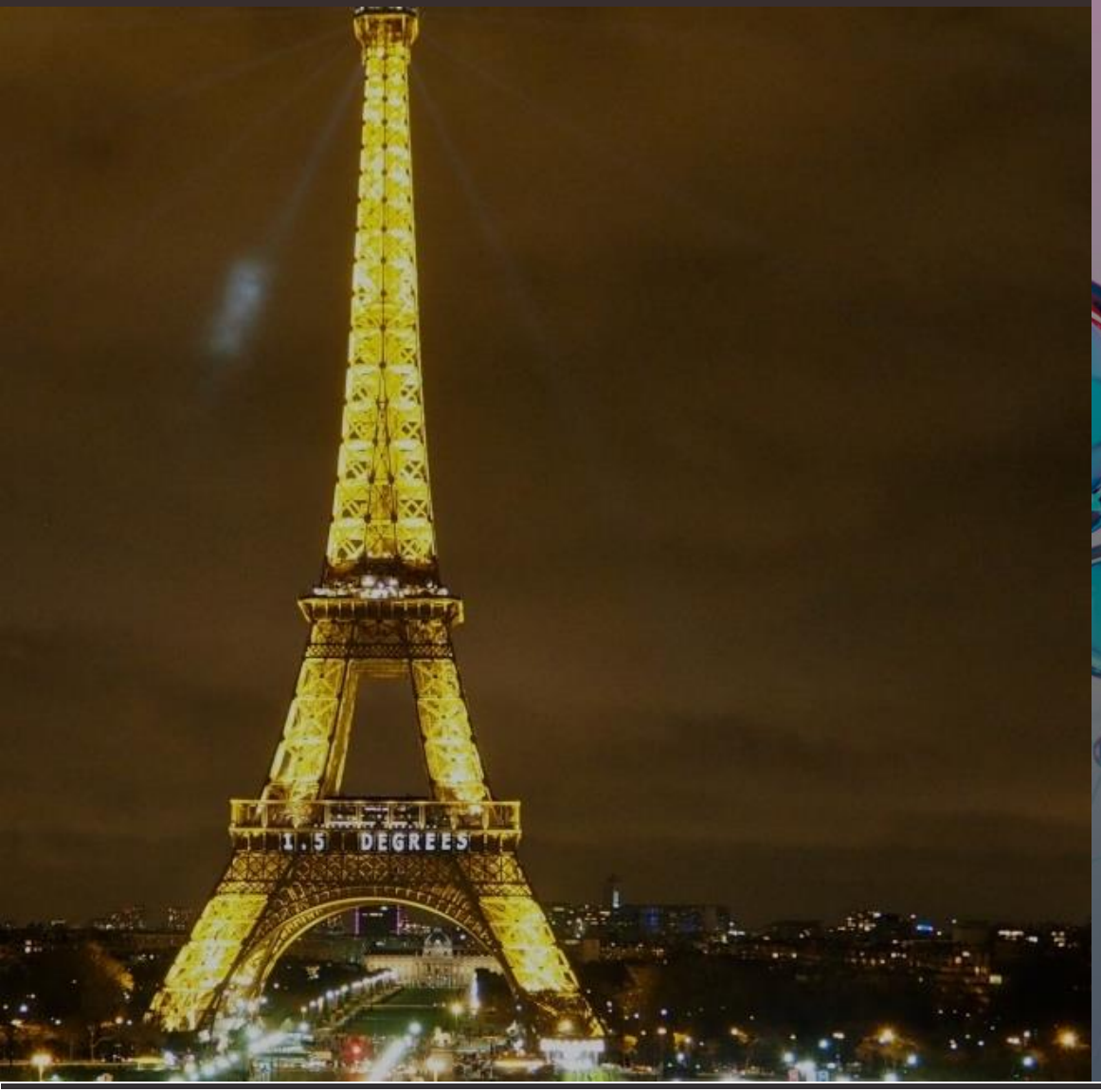
- Is it possible to increase recycling or use take-back schemes ? What about promoting re-use?

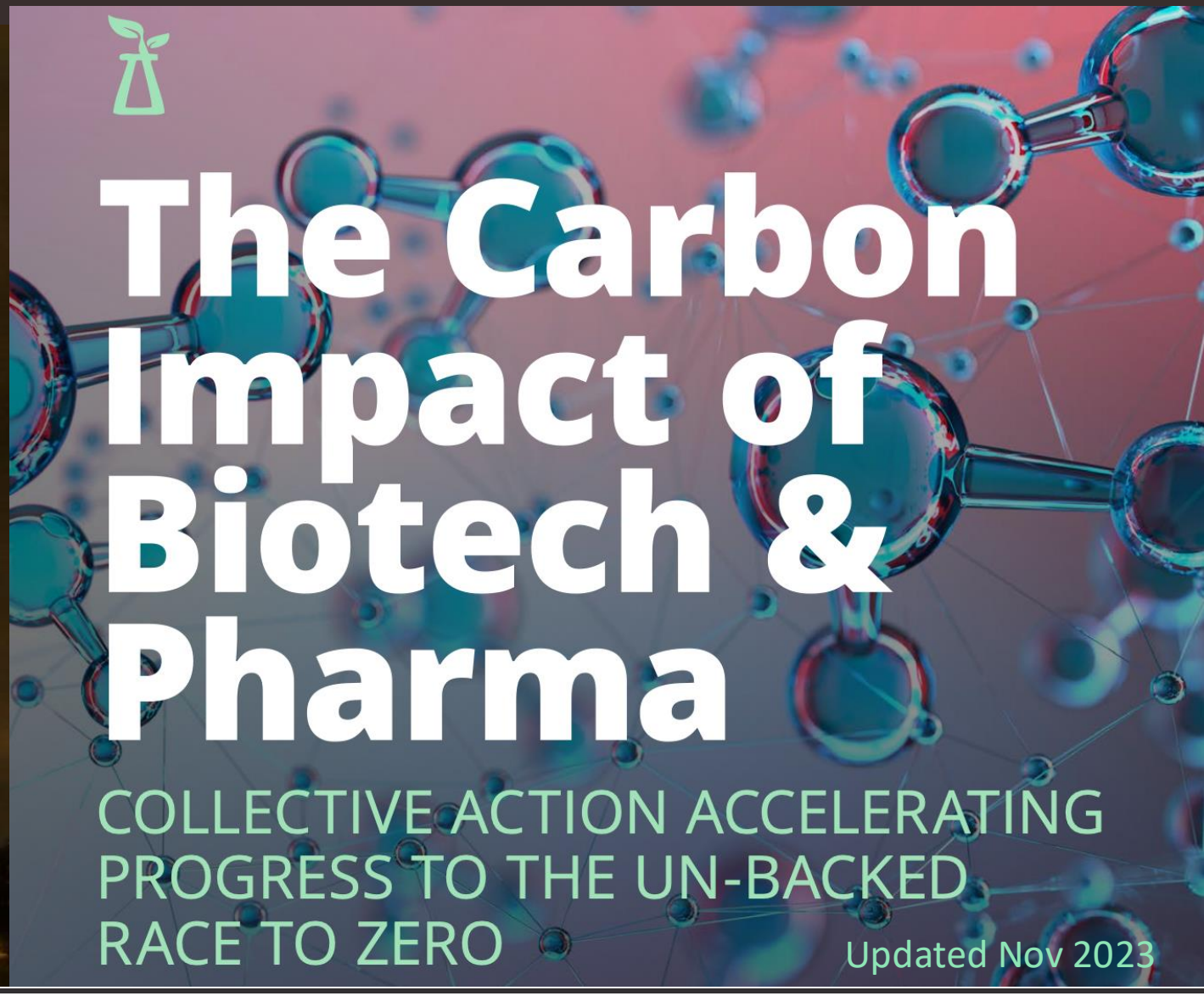
Procurement

Procurement refers to all steps involved in the process of ordering goods and services, from how it is sourced, transported, received and recorded.

If you are familiar with carbon emissions reporting, procurement falls into "Scope 3 Emissions", which for biotech and pharma organizations are nearly FIVE TIMES LARGER than Scope 1&2 Emissions combined.

The Carbon Impact of Biotech And Pharma

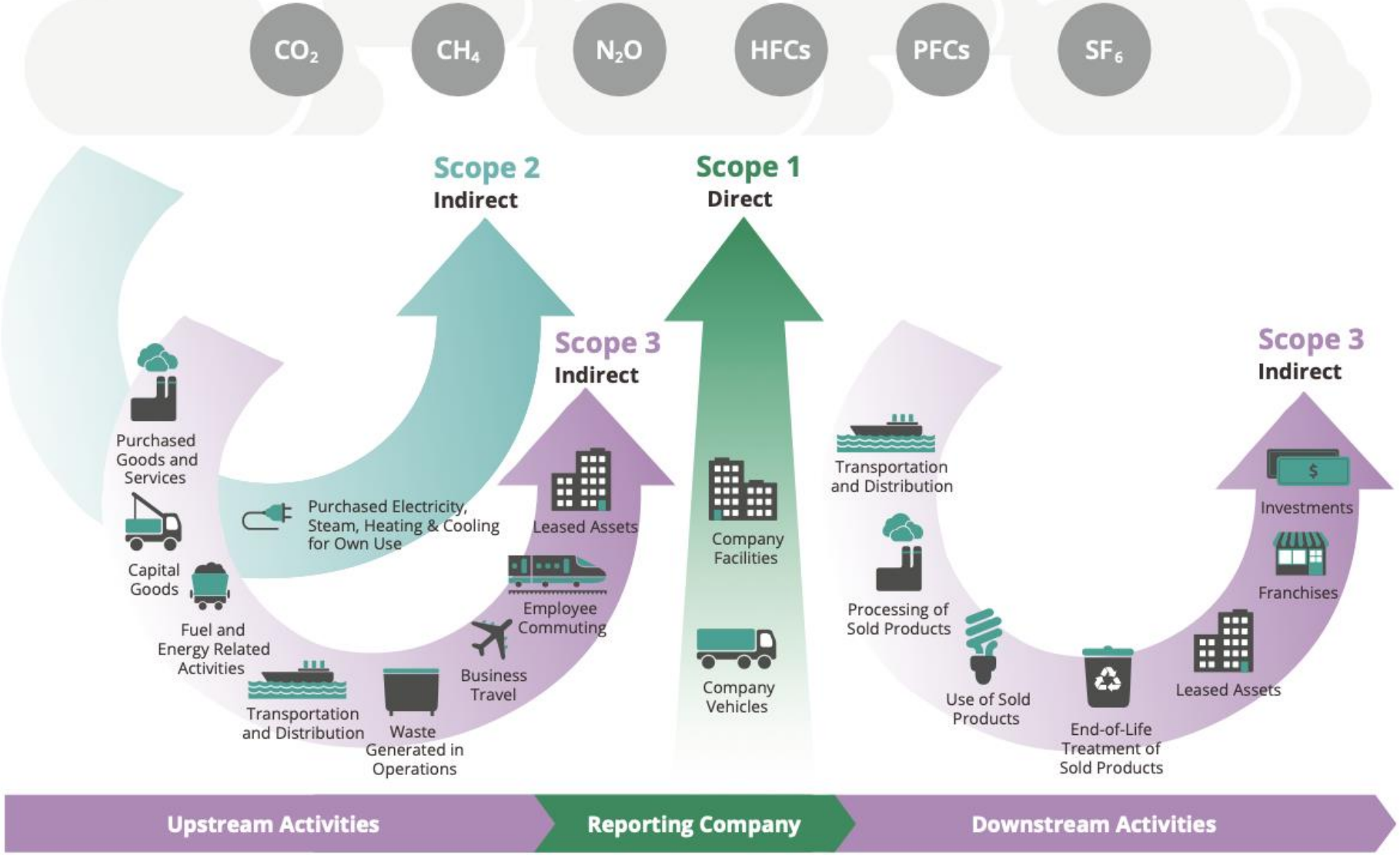




Reference: Link

my green lab.

Types of Emissions



Credit: Greenhouse Gas Protocol — Corporate Value Chain (Scope 3) Accounting and Reporting Standard

my green lab.

The Takeaway

Sustainable procurement (purchased goods and services) is essential to reducing the impact of our labs!

my green lab.

Purchasing

- Purchase price
- Shipping

my green lab.

Purchasing

- Purchase price
- Shipping

- Energy use
- Water use
- Reagents & consumables
- Maintenance
- Service contracts
- Disposal

my green lab.

Sustainable Procurement Strategies

- Use Third-Party Verified Eco Labels to understand the environmental impact of products
- Consolidate orders from the same company – this requires a bit of coordination among the lab team!
- Use supply centers and stock rooms when available

Bio-Rad Supply Center

Thermo Fisher Supply Center

ACT.
The Environmental Impact Factor Label

ENERGY STAR

my green lab.

ACT.

The Environmental Impact Factor Label

actdatabase.mygreenlab.org

Accountability

- Holds manufacturers responsible for reducing the environmental impact of their products.

Consistency

- 3rd party verified standard executed by independent auditors.

Transparency

- Discloses strengths and weaknesses that drive continuous improvement.

an ecolabel for laboratory products

my green lab.

ACT 2.0 Coming Soon…

- Communicate sustainability attributes clearly and directly
- Weight categories to reflect true environmental impact
- New Scope 1/2/3 + Product Co2e Section
- Facilitate portfolio-wide product certifications for manufacturers
- Single Globally applicable label per SKU
- Third Party Verified

1,500+ Products, 40+ Companies
Many More Coming in 2025
ACT.MyGreenLab.Org

Consumables

QIAGEN
SARTORIUS
METTLER TOLEDO
eppendorf
labcon
ThermoFisher SCIENTIFIC
MilliporeSigma
ARVENSIS
RAININ Pipetting 360°
burkle
MERCK
Biosigma
MICRONIC
POREX Filtration Group
KIMTECH
DIVERSIFIED BIOTECH
cytiva
USA SCIENTIFIC
alphalaboratories supplying quality to science
greiner BIO-ONE
KLEENGUARD

Chemicals/Reagents

MilliporeSigma
Promega
MERCK
QIAGEN
Invitrogen living science
ThermoFisher SCIENTIFIC
FUTURE FIELDS

Equipment

cytiva
KNAUER
SHIMADZU Excellence in Science
Roche
envetec
PEAK SCIENTIFIC
B medical systems
ThermoFisher SCIENTIFIC
Miele
STERILIS SOLUTIONS
DeNovix
Agilent
METTLER TOLEDO
CoolLED Simply Better Control
CSS CONSOLIDATED STERILIZER SYSTEMS
CHART
eppendorf
Thermo SCIENTIFIC
Waters™
Biolife Solutions
INFORS HT
BÜCHI

Plug Loads

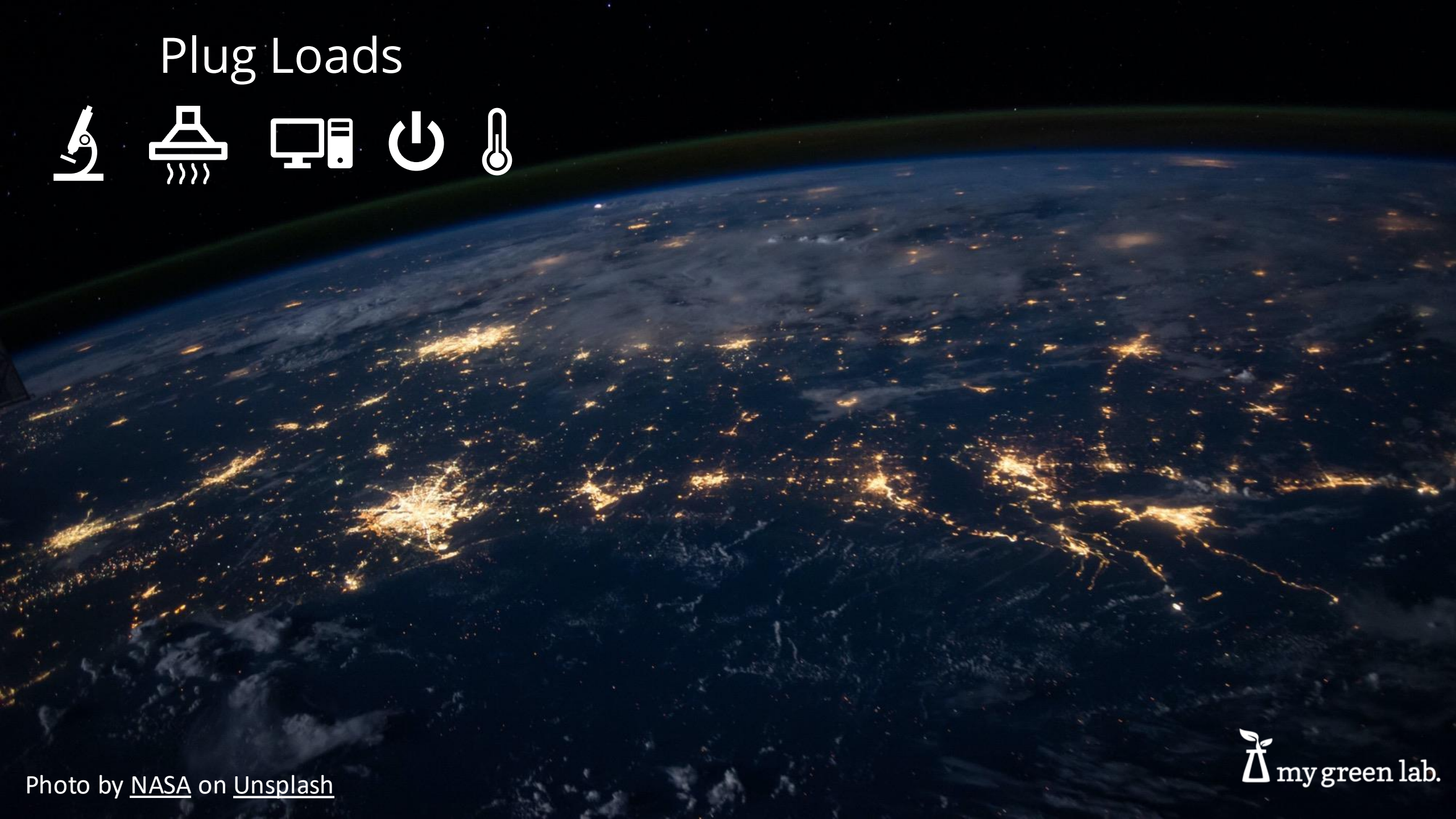
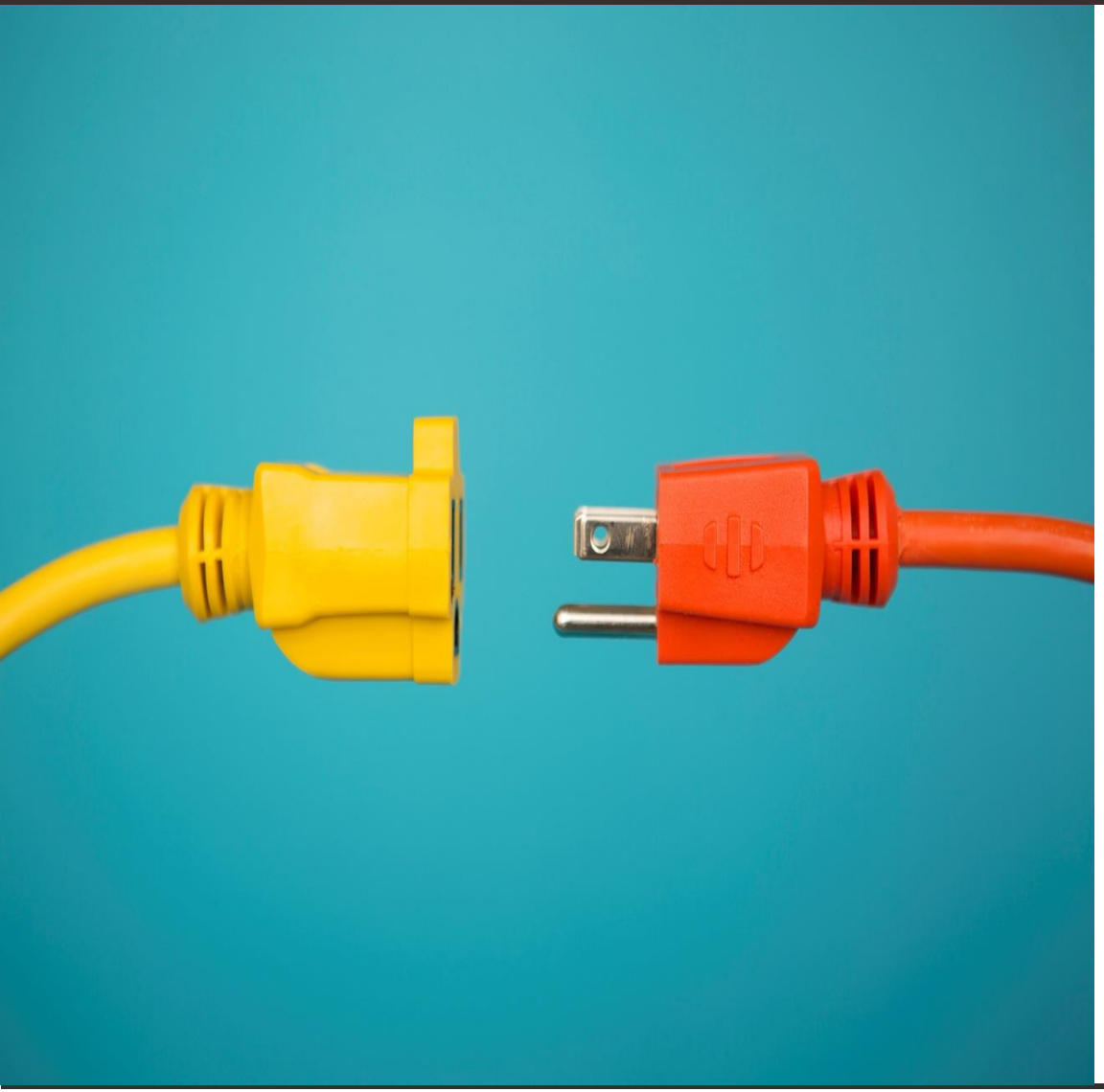


Photo by NASA on Unsplash

my green lab.

What is Plug Load?



Everything that you plug into the wall

- Pipettes
- Shakers
- Computers
- Lasers
- Microscopes
- Centrifuges
- Freezers
- etc.

It may seem like laboratories are an insignificant contributor to climate change

BUT estimates emissions from laboratory buildings are 5% of all commercial building emissions (in the United States, ref). This is 40 million metric tons of carbon dioxide equivalent (MtC02e) a year!

Examples:

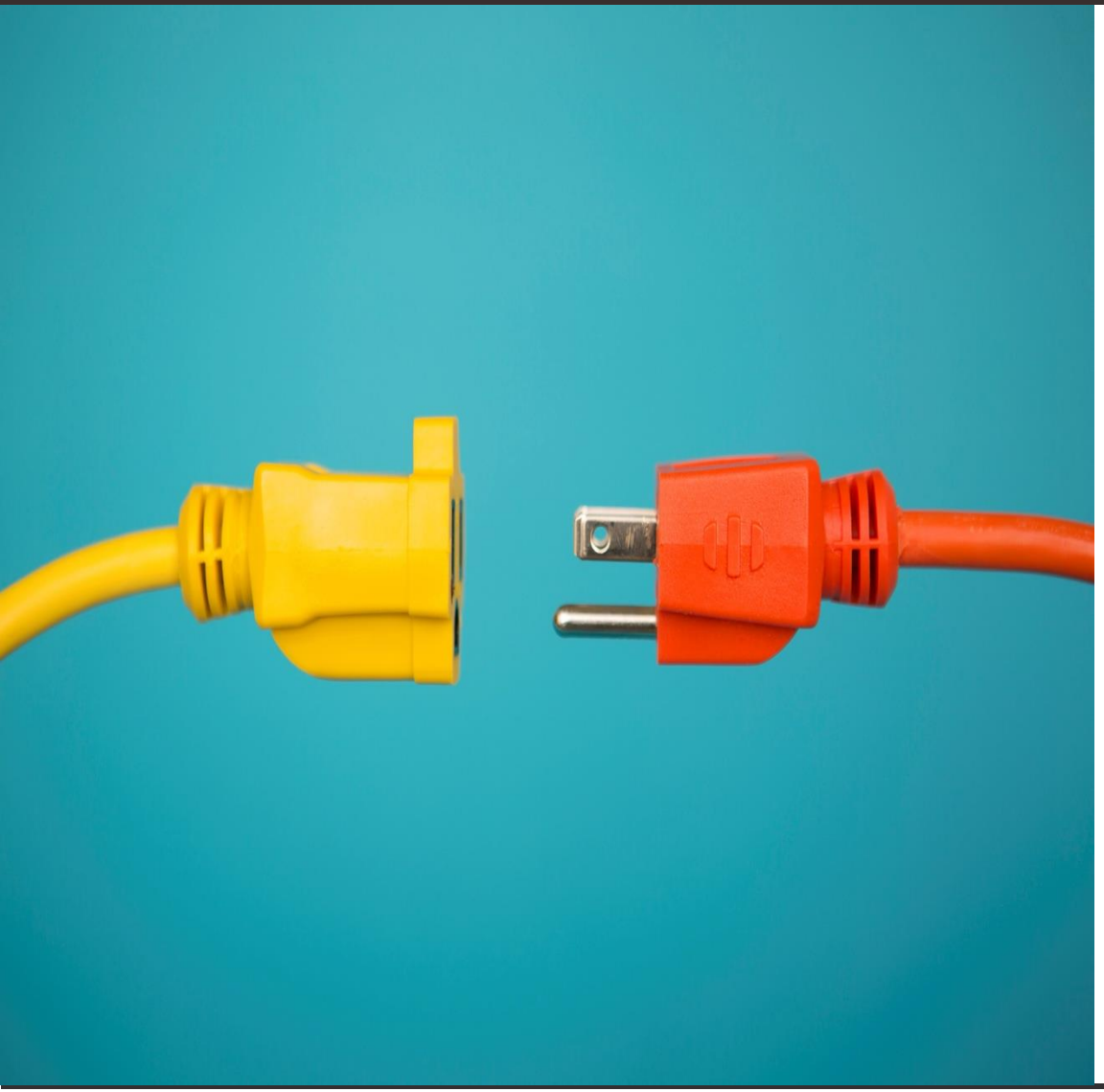
At Harvard University, labs account for 22% of building space but are responsible for 46% of campus energy consumption.

At Stanford University, lab equipment alone made up 50% of total plug load energy consumption across campus

Rethinking Energy

- Make sure **lights get turned off** in the lab and support rooms
- **Turn off equipment** when it is not in use
  - Focus on equipment with heating and cooling or vacuums – **outlet timers** make it easy
- Use sleep and **energy saving modes**
- **Don't use screensavers** on your computers – allowing your monitor to turn off can save the equivalent of driving your car nearly 25 miles!

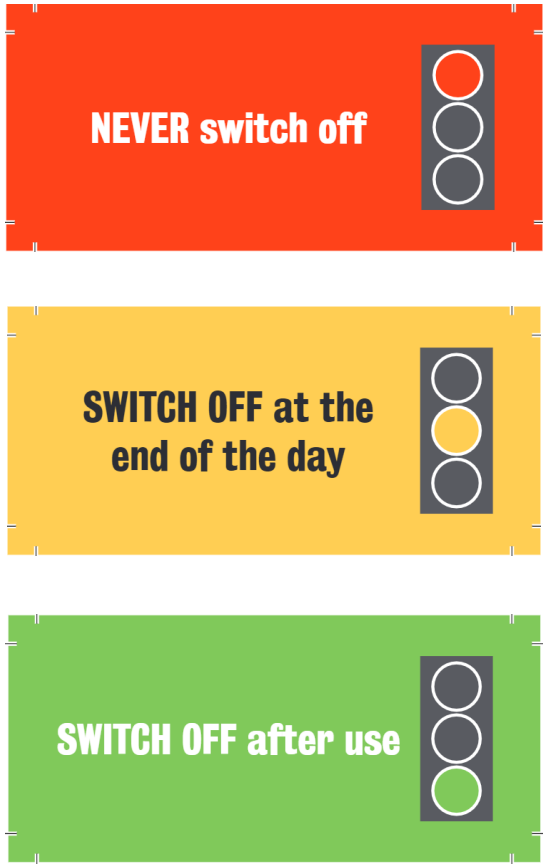
Top Candidates



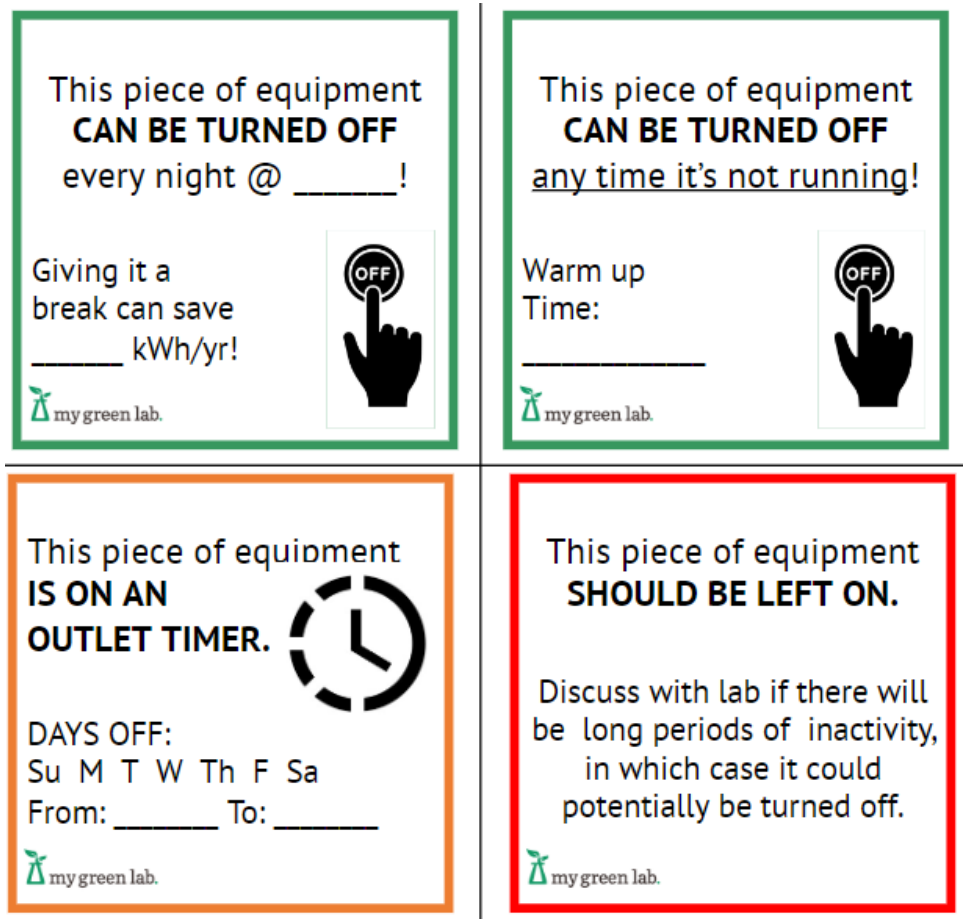
Equipment that pulls the most power

- Anything with a heating or cooling element
  - e.g. water baths, drying ovens, incubators
- Anything that pulls a vacuum
  - e.g. vacuum pumps, mass spec, gloveboxes

Stickers! Get Organized, Make it Known



Sticker 1



Sticker 2

my green lab.

Turn Off Equipment

Good candidates

- COMPUTERS!
- Water Baths
- Autoclave
- Electric microscopes
- Centrifuges
- Heating Plates
- Stir Plates
- Drying Ovens
- PCR Machines
- Vacuum Pumps
- Rotovaps
- Electric Balances

Not good candidates

- Mass Spectrometers
- HPLCs
- NMR
- ICR; ICR-MS
- Equipment with magnet components

Be Good in the Hood

- Fume hoods can consume as much as **3.5 homes worth of energy**!

- **Shutting the sash** on your fume hood could **save 2 homes worth of energy**
- Make sure **excess equipment and supplies** are not stored in hoods, blocking air flow
- **Turn off the lights** when not in use

Cold Storage Best Practices

- **Chilling up -80s to -70°C** can save around 30% of the energy consumed
- Purchasing **Energy Star** freezers
- **Retire** freezers that are no longer needed
- Keep a sample inventory and periodically **purge unneeded samples**
- Keep cold storage operating at **maximum efficiency**:
  - Maintain door seals
  - Defrost and remove ice
  - Clean filters and vacuum coils – this can save 5%


Image: https://www.dpr.com/projects/biogen-building-8-floors-4-5-lab-renovation

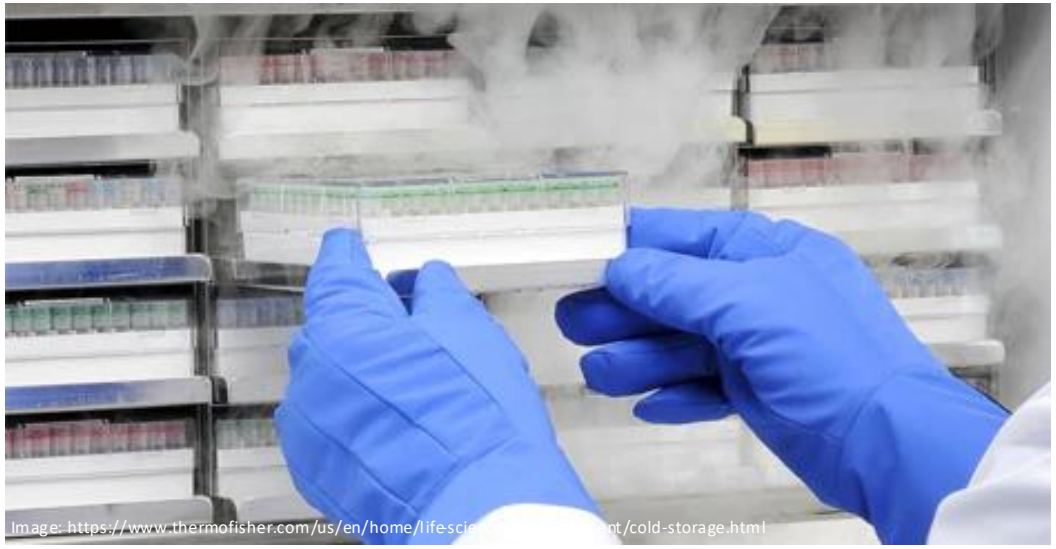
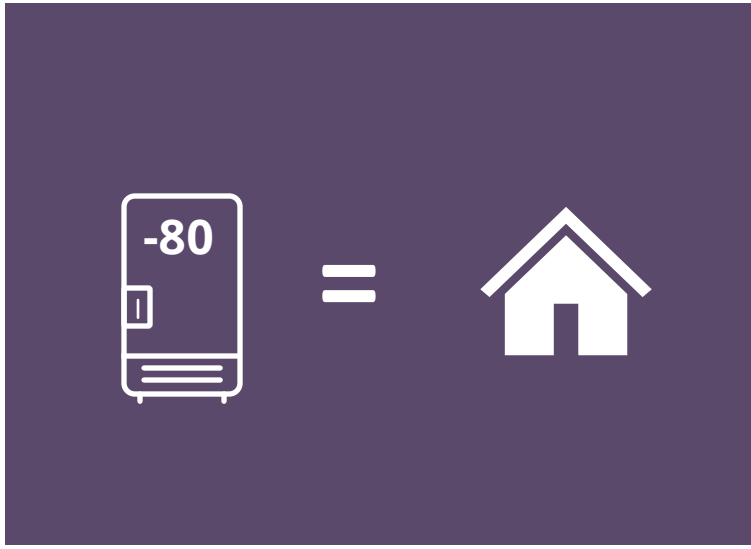


Image: https://www.thermofisher.com/us/en/home/life-sci nt/cold-storage.html



Join the Freezer Challenge!

Who: All laboratories from all sectors that have cold storage

Why: Improve energy efficiency, sample integrity, sample access, risk prevention, and cost savings

When: Every year, January 1 to July 1

Cost: It's free!

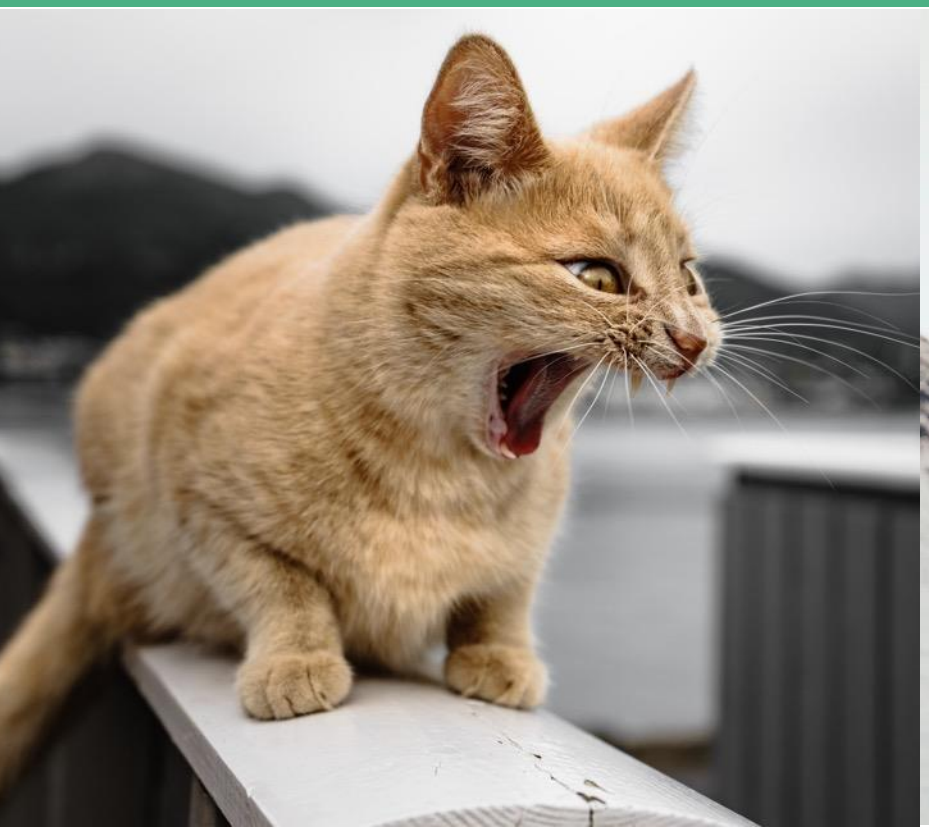
Register: https://freezerchallenge.mygreenlab.org/

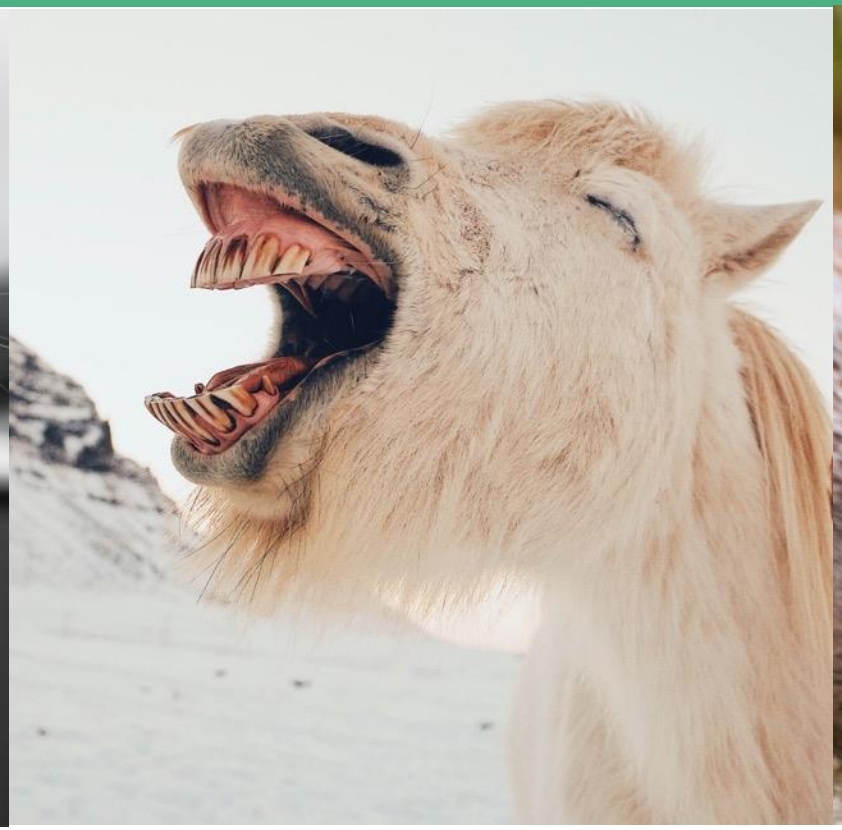
freezer challenge

my green lab.

I2SL International Institute for Sustainable Laboratories

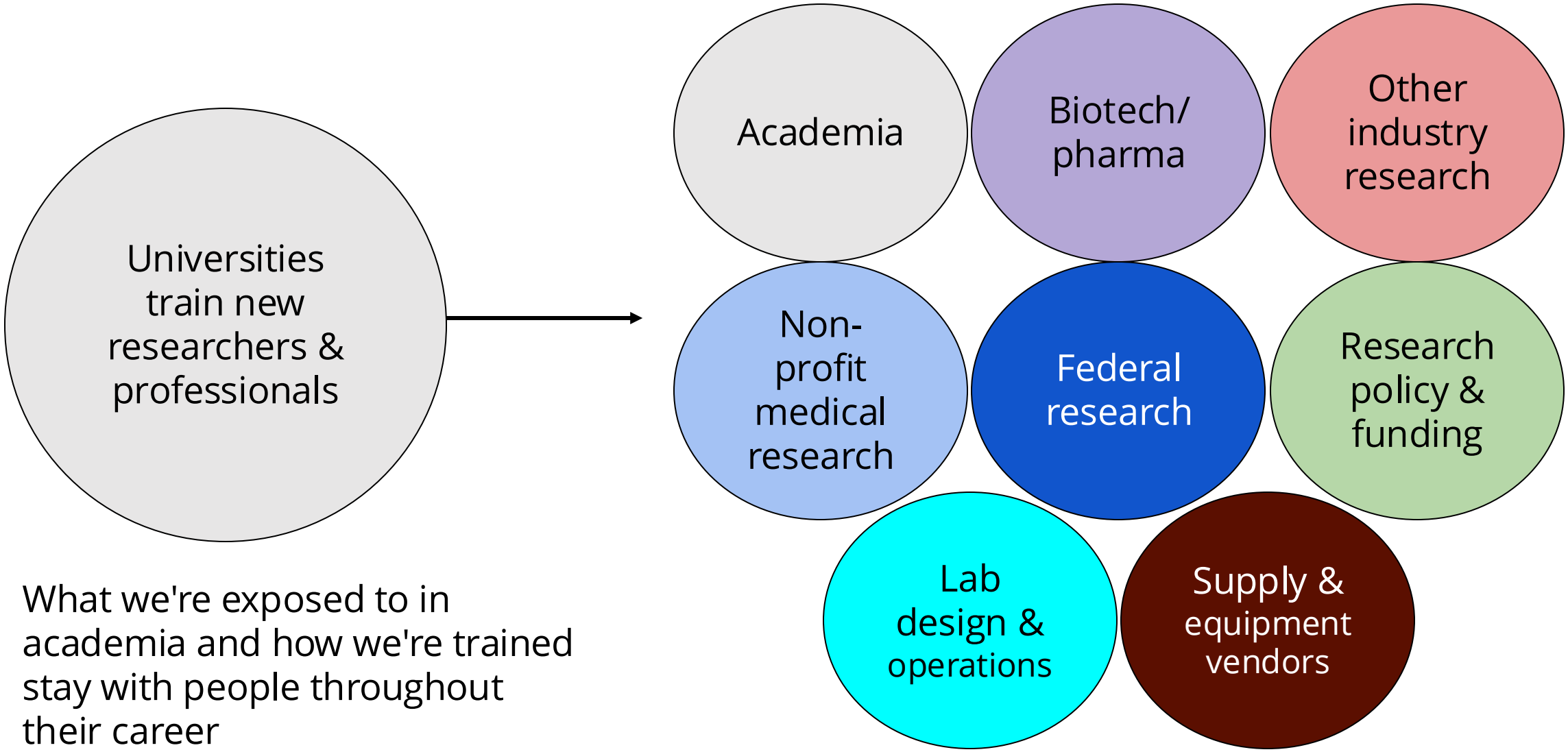
Your Voice Matters





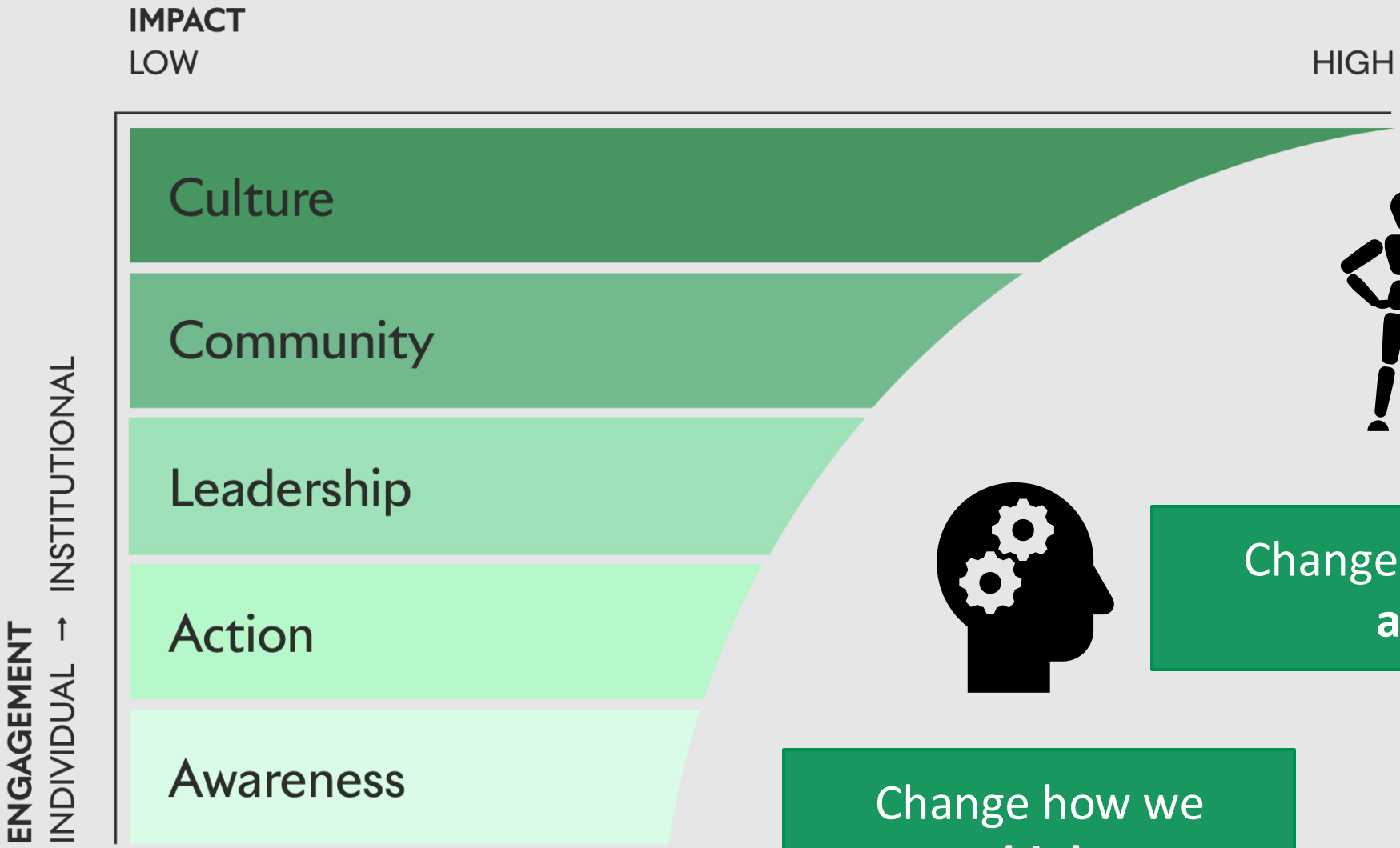
my green lab.

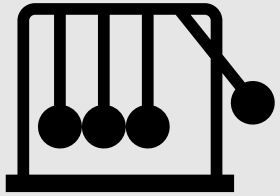
Cultural change within academia is so important

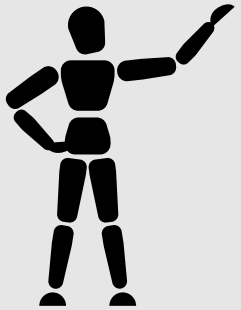


What we're exposed to in academia and how we're trained stay with people throughout their career

My Green Lab's Theory of Change







Change the Scientific Enterprise

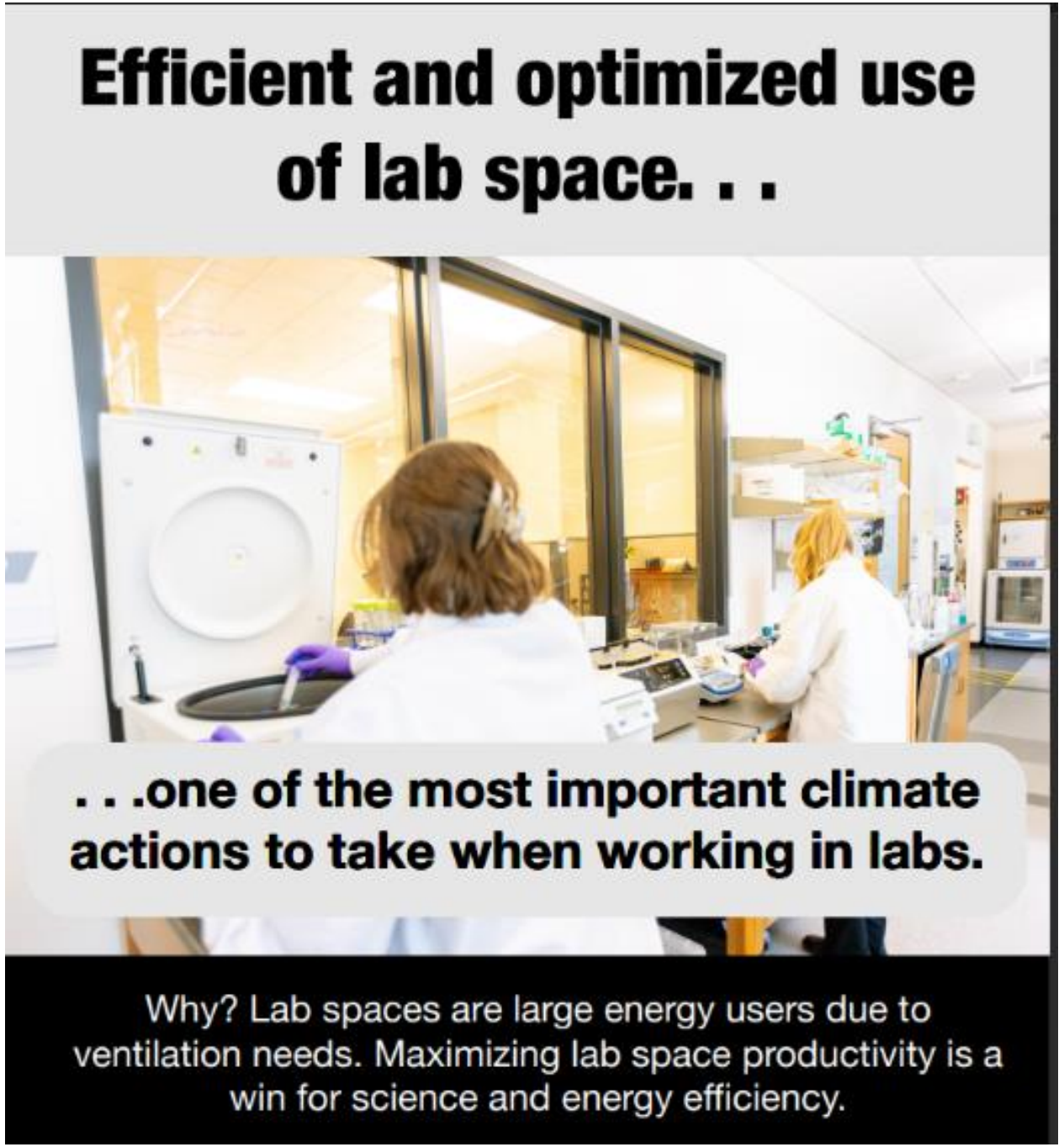
Change how we **act**

Change how we **think**

my green lab.

System change example with large cost avoidance:

Lab space optimization: periodic assessment & reallocation of lab space



2021 CU Anschutz Med School Lab Cleanup and Space Evaluation Project

- Lab space needed for incoming faculty
- Charge came from Dean of Medical School to look at existing lab space use
- 52,000 m^2 walked and assessed by two teams:
  - Senior scientists
  - EHS leadership & Facilities personnel
  - Dean's Office Leadership & Research Affairs

John J. Reilly, Jr., MD

VC for Health Affairs and Dean CU School of Medicine

Many thanks to CU Anschutz School of Medicine for sharing this information with I2SL and giving a webinar on the topic (recording is linked on the I2SL LabSavers webpage: https://www.i2sl.org/labsavers)

School of Medicine
UNIVERSITY OF COLORADO
ANSCHUTZ MEDICAL CAMPUS

Identifying laboratory space being used as storage spaces

School of Medicine
UNIVERSITY OF COLORADO **ANSCHUTZ MEDICAL CAMPUS**

Result: >4,000 m^2 of underutilized lab space reclaimed

- Disposed 1360 kg of chemicals
- 226 metric tons of waste (~20% recycled)
- 4000 items collected for reuse
- “Clutter and antique/unused equipment is a huge problem…”
- Research space guidelines revised & new process in place to review lab space use annually

92,700 €

Cleanup Cost

vs.

>41,000,000 €

New Construction

My Green Lab Program Ecosystem

Certification

Advocacy & Education

Campaigns

My Green Lab Certification

International 'gold standard' for laboratory sustainability best practices.

The ACT Label

The world's premier eco-label for laboratory products that ensures Accountability, Consistency and Transparency in order to enable sustainable laboratory procurement.

Freezer Challenge

International competition to encourage cold storage best practices.

My Green Lab Ambassadors

Global community of green lab enthusiasts that have been educated and empowered to bring green lab principles into their work and research.

My Green Lab Accredited Professionals

The first credential of its kind developed to offer scientists an opportunity to grow their knowledge and demonstrate their expertise in lab sustainability.

UN Race To Zero

MGL is a delivery partner for the UN RtZ, working to enable the systemic transformation of the Biotech and Pharmaceutical sector. MGL Certification has been selected as a key indicator in the 2030 Breakthrough Outcomes campaign.

Million Advocates

Global advocacy campaign requesting action from funding bodies to prioritize sustainability in the way research is conducted.

my green lab.

my green lab certification.

1 Assess Baseline

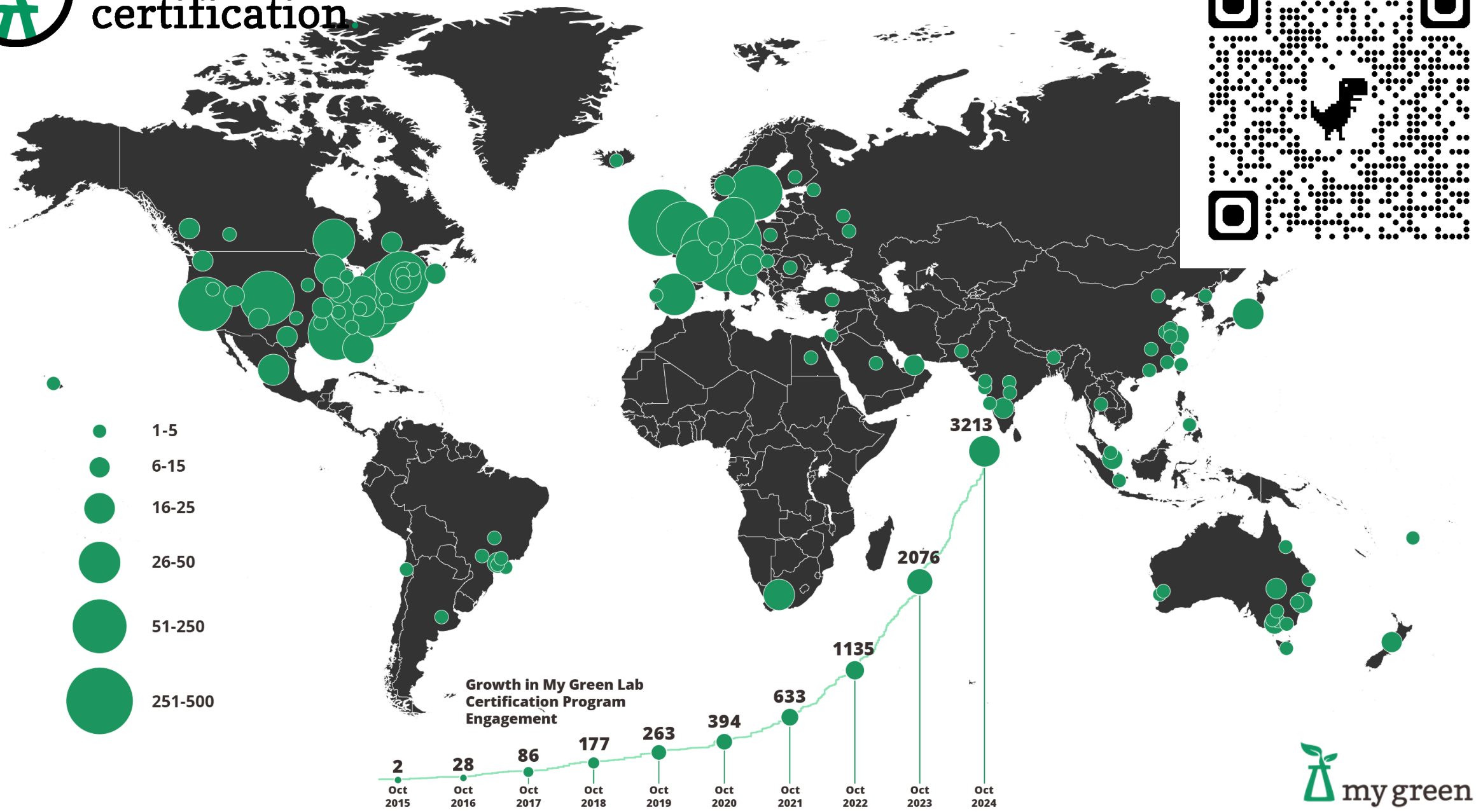
2 Implement Changes

3 Get Certification

4 Make More Changes

5 Do Re-Certification

my green lab certification



my green lab.

Designed for scientists and laboratory professionals to drive sustainable lab practices

- Free, online learning program
- Provides ideas for how sustainable actions can be implemented and communicated with lab members

What does the Ambassador Program Cover?

Energy

Waste

Water

Green Chemistry

8000+ Ambassadors

Over 50 countries represented

My Green Lab Accredited Professional Program

Become a Certified Green Lab Expert!

www.mygreenlab.education

All modules now available!

Demonstrate your expertise of green labs through the industry's first professional accreditation

Each module includes an in-depth discussion of green lab topics and solutions

Waste

Energy

Water

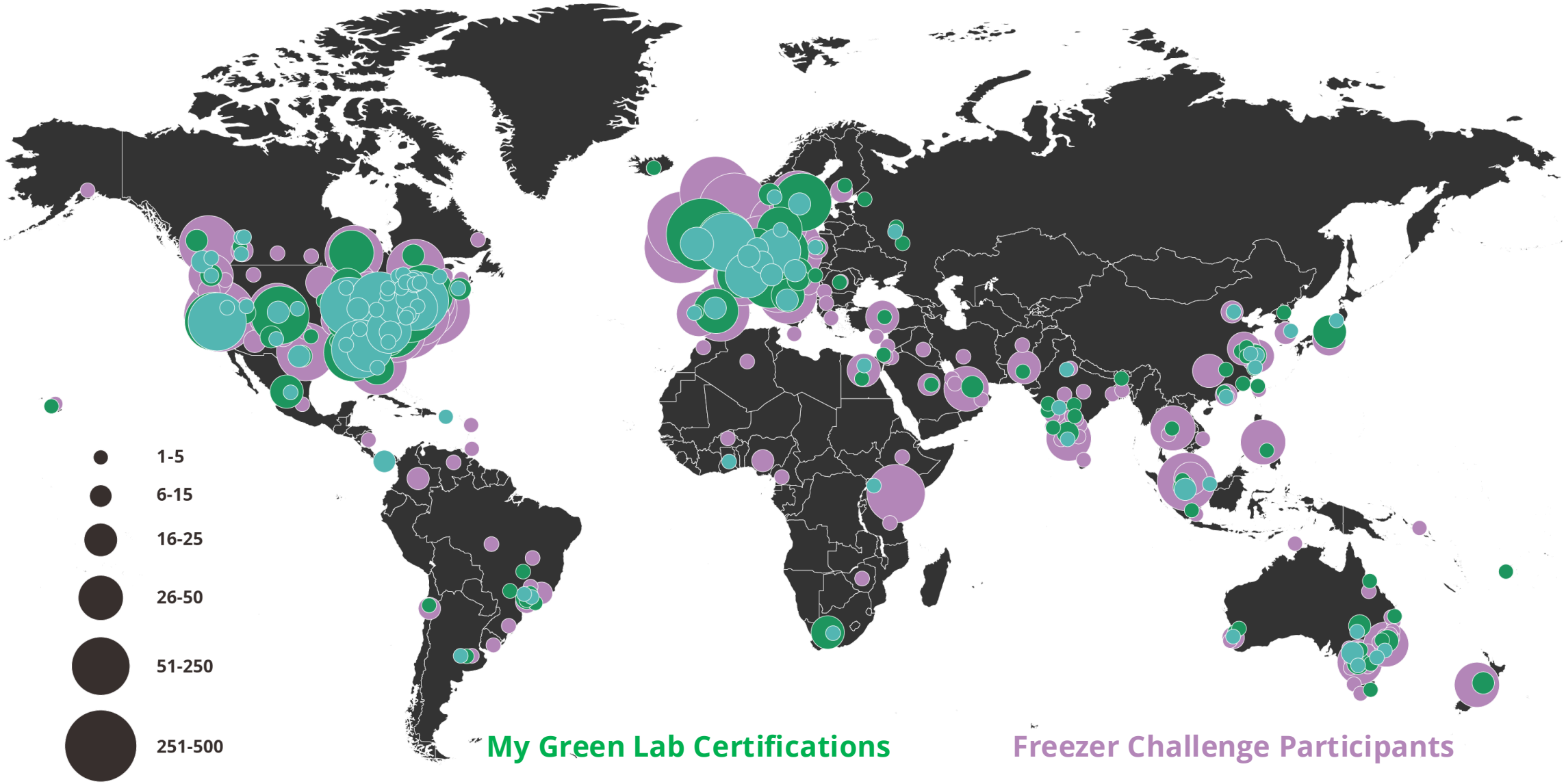
Procurement

Green Chemistry

Engagement

Discounted Pricing for Students and University/NGO/Government Professionals

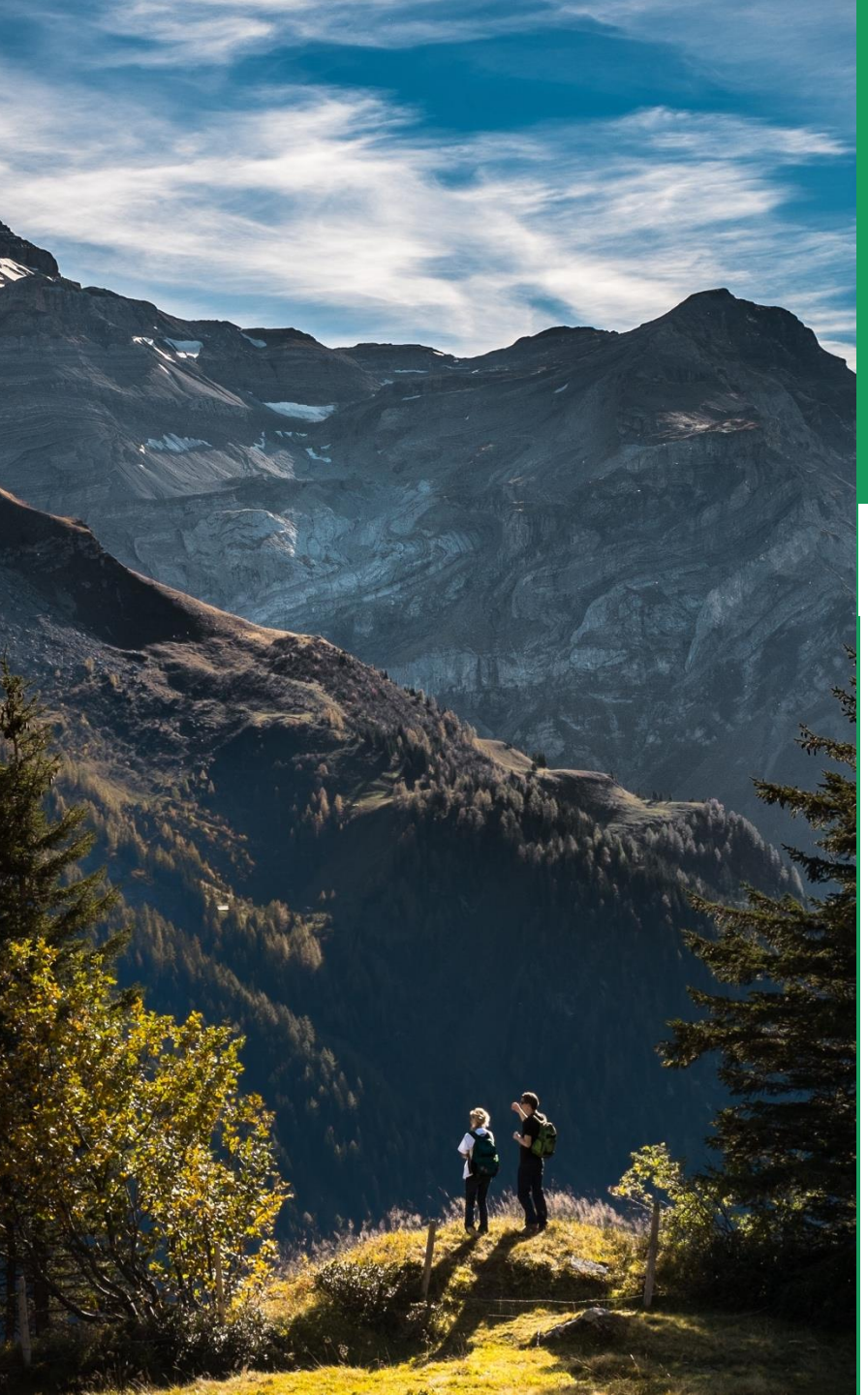
Asking “Why” All Over the World



A Few Take Away Messages

- It starts with you!
- Get involved in institution-level change too if you can
- Do the Freezer Challenge!
- Join the My Green Lab newsletter
- Start somewhere

my green lab.



"Never doubt that a small group of thoughtful, committed citizens can change the world; indeed, it's the only thing that ever has."

- **Margaret Meade**

Thank you to our Sponsors!

christina@mygreenlab.org

Annual Sponsors

Visionary

AstraZeneca

Transformative

Agilent, Cell Signaling Technology, envetec, MilliporeSigma, ThermoFisher Scientific

Breakthrough

Roche, AMGEN, RAININ, RightCycle, avantor, Bristol Myers Squibb, erlab, PHCbi

Discovery

GILEAD, Stirling Ultracold, sanofi, ucb, Takeda, Promega, labcorp, QIAGEN, Waters, GSK, abbvie

Experimental

WoodSafe, eppendorf, Grenova

Investigation

New England Biolabs

Accelerator Partners

Platinum

Triumvirate Environmental

Gold

Arcondis

Silver

LifeBee

Bronze

Carpus+Partner, Waldner, Sustainable Lab Solutions