

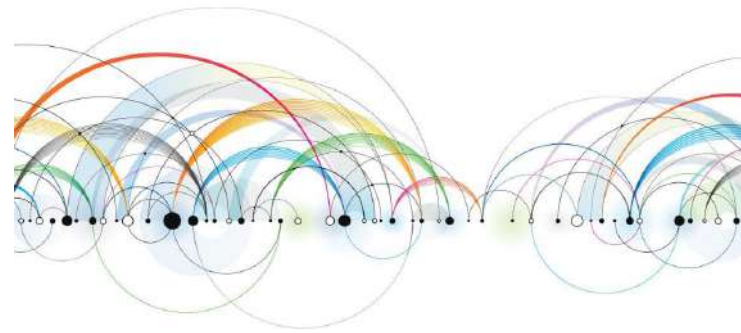


Environmentally Sustainable Science and LEAF

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Sustainable Research Manager (King's College London)
Director (Green Lab Associates)**

Science – Does some good stuff

- Recent Highlights include:
 - CRISPR/Cas9 editing
 - Male contraceptives
 - Artificial wombs (for sheep)
 - A new (drowned) continent! Zealandia
 - Most even agree on climate change (concern has risen from 66% to 70% from 2015-2016)¹
 - 12 billion yr old Oxygen molecule (UCL)
 - Memory transfer to snails
 - Warm blooded fish discovery
 - Addressing Covid-19!

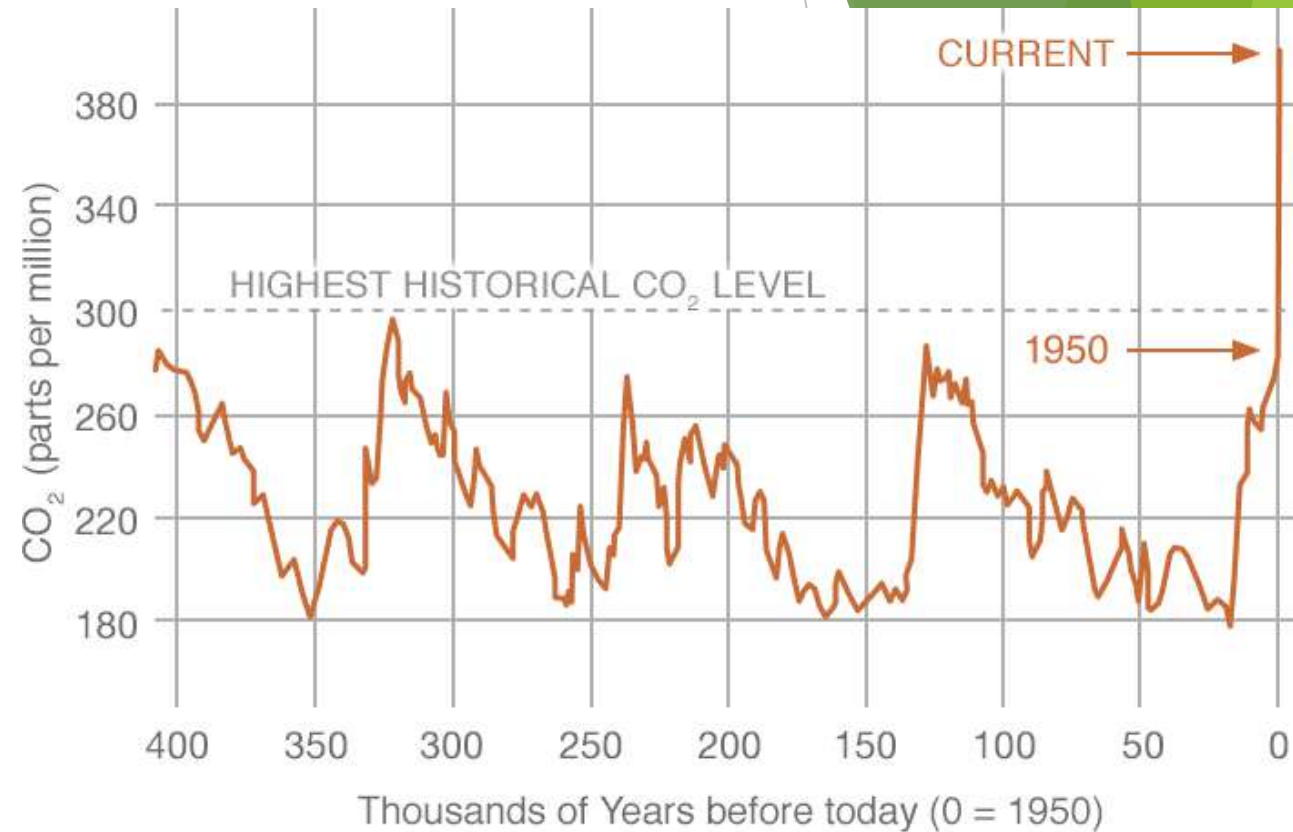


¹https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/602458/PAT_wave_17_Summary_of_key_findings.pdf

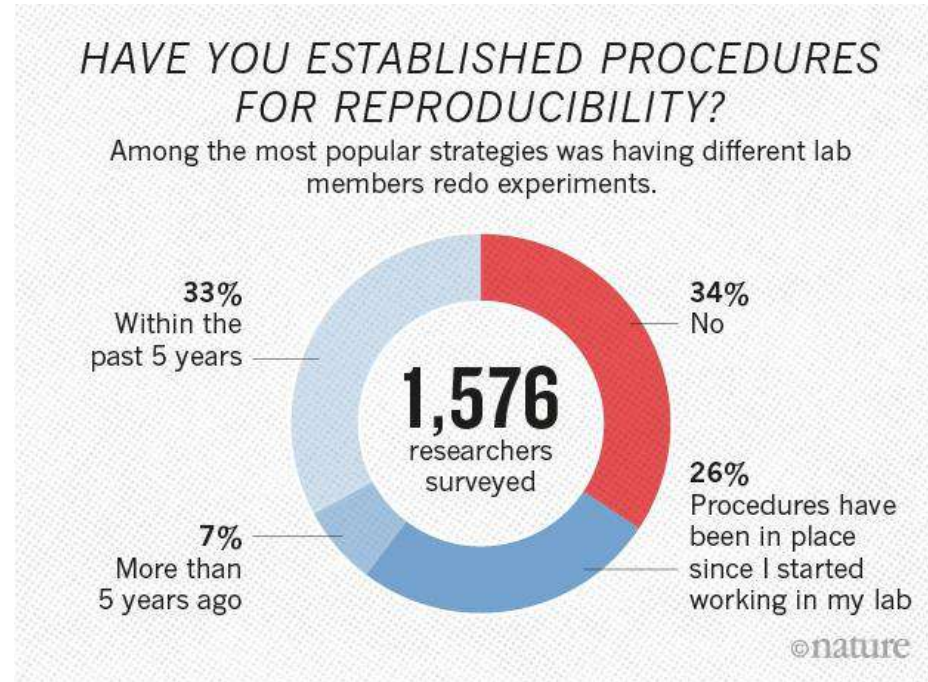
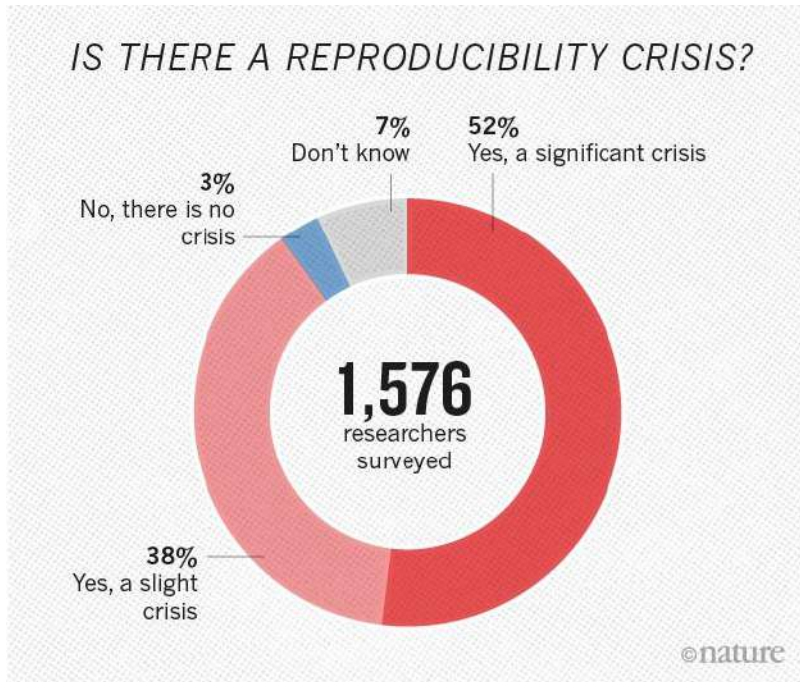
Sustainability in Science

- There are growing numbers of people working in research
- Plenty left to research
- Overall sums of investment are increasing, *but* winning a grant is extremely competitive. More collaboration required
- Increasing interest in the systems of science (data management, quality)

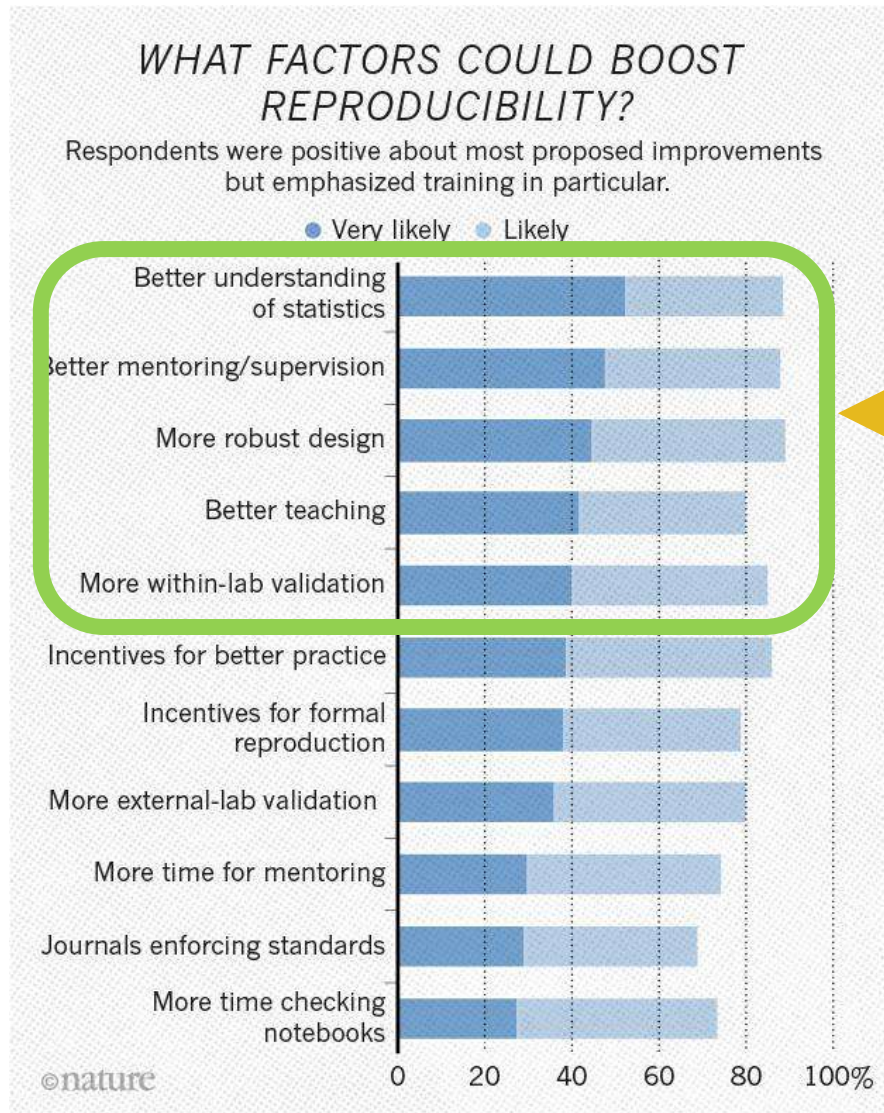
<http://climate.nasa.gov/vital-signs/carbon-dioxide/>



Crisis of Reproducibility



Crisis of Reproducibility



Achieved by
good laboratory
management &
procedures

- We must look at *how* we conduct the research - Sustainable Science
- Integration efficiency and sustainability are a way to mitigate some of the growing challenges
- How to balance UK's promise to increase investment in research with carbon-neutrality targets





Quiz

1) Lab plastics are estimated to contribute ...?... to the total global plastic waste in 2014.

- a. 0.001%
- b. 0.6%
- c. 1.8%
- d. 5.3%

Source: “Labs should cut plastic waste too” Urbina., M, Nature Articles

Quiz

2) A typical new ULT freezer will consume as much energy in a year as:
(UCL has 500+)

- a. An average UK household
- b. An average US person
- c. An average UK person
- d. Charging 50 phones all the time (for a year)

Quiz

3) What piece of standard lab equipment consumes the most energy?

- a. Fume cupboards
- b. Centrifuges
- c. Ovens
- d. Biological safety cabinets

Quiz

4) X % of health care waste is hazardous according to WHO (a typical lab throws out 70-90%)

- a. 5%
- b. 15%
- c. 25%
- d. 35%

Source: <https://www.who.int/news-room/fact-sheets/detail/health-care-waste>

Quiz

5) Between 2007 and 2013 the world economy grew by 20.1%, how fast did gross expenditure on research and development (GERD) grow by?

- a. 22.2%
- b. 20.1%
- c. 5.5%
- d. 30.5%

Quiz

6) Researchers accounted for what percentage of the world population?
(2013)

a. .001%

b. .1%

c. 0.5%

d. 1%

Quiz

7) How much does science grow by every year?

a. 1-2%

b. 3-5%

c. 5-6%

d. 8-9%

- Bonus! How often then does scientific output double?

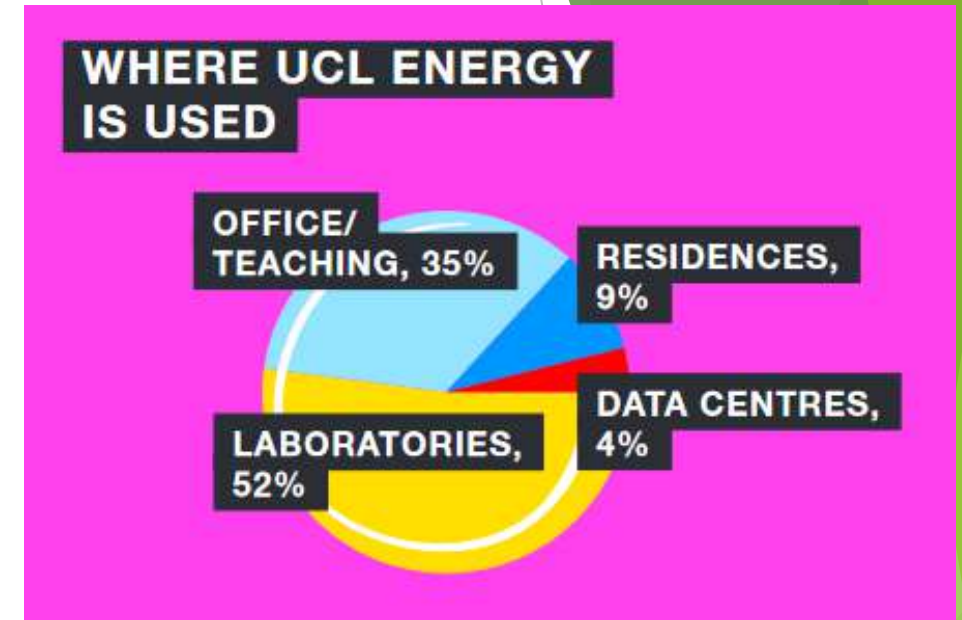
Ref: Growth rates of modern science: A bibliometric analysis based on the number of publications and cited references:
Growth Rates of Modern Science: A Bibliometric Analysis Based on the Number of Publications and Cited References. -
Lutz Bornmann, Ruediger Mutz, 2014

Quiz

8) What % of research conducted gets published? Or shared widely?
Or is accessible?

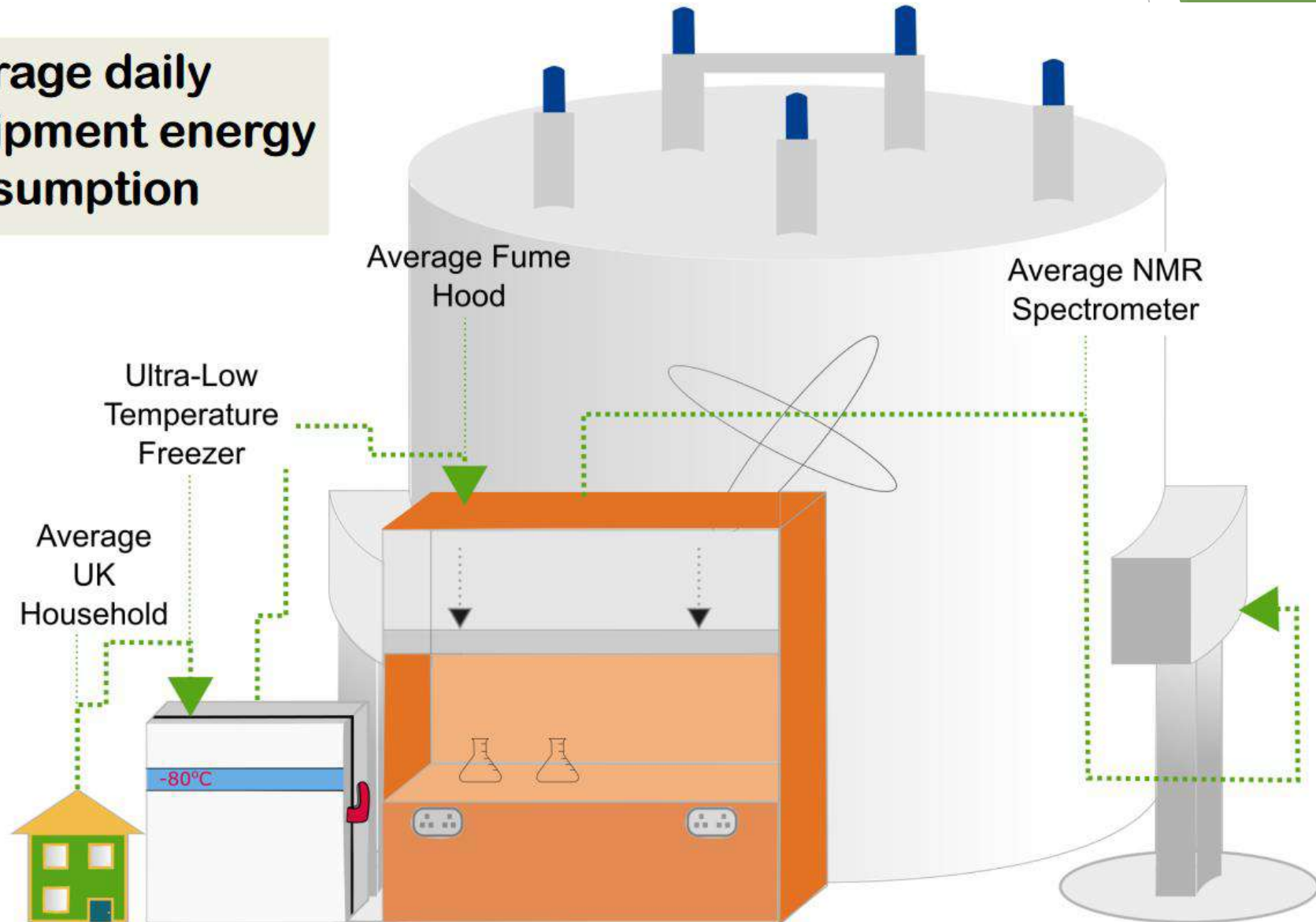
Laboratories

- Labs consume 3-10 times more energy per m² than academic spaces
- Typical research institution will have 50-65% of energy to labs
- Often unaddressed due to specified nature of research - though some processes are common enough.



Laboratories

**Average daily
equipment energy
consumption**



Sustainable Labs Today

Sustainable / Green Labs

Green Chemistry



Built Environment

- BREEAM, Passive house labs?
- SKA Labs
- Ventilation Rates
- Net-zero construction



Equipment & Consumables

- Sustainable Tenders
- Manufacturers Impact
- NEED Life-cycle carbon assessments

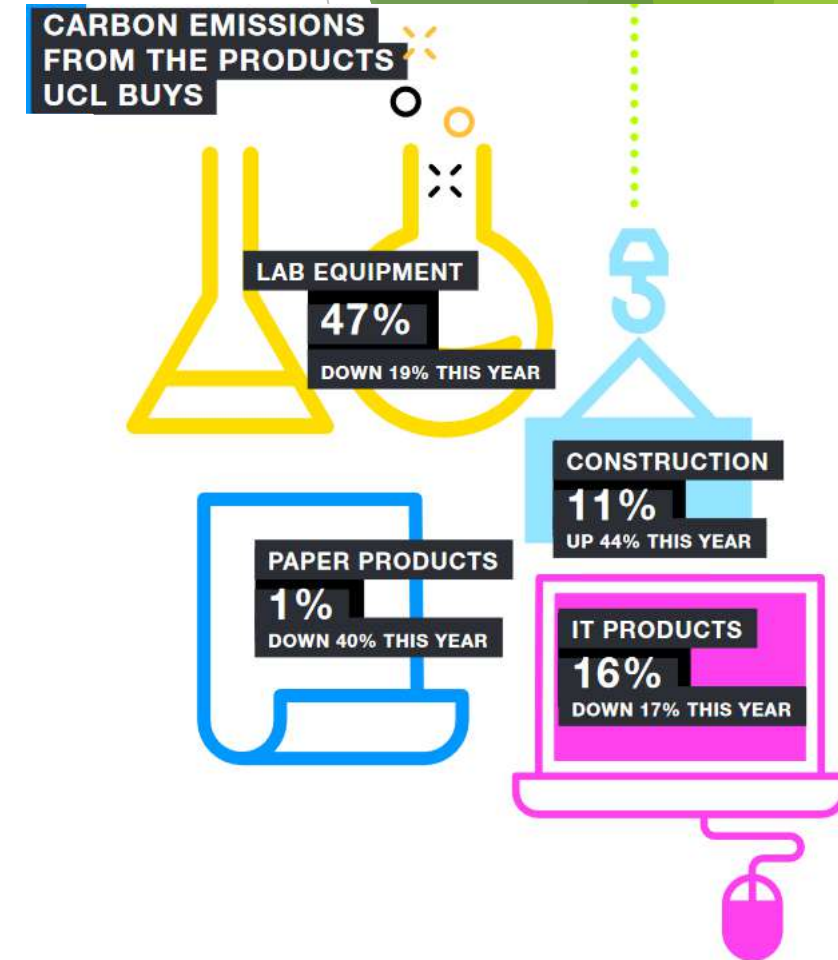
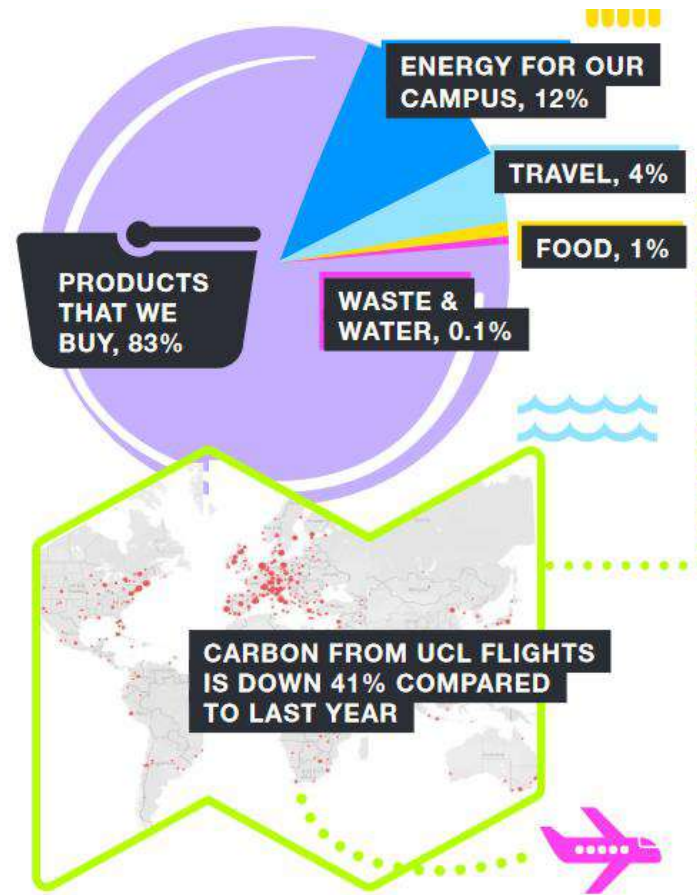


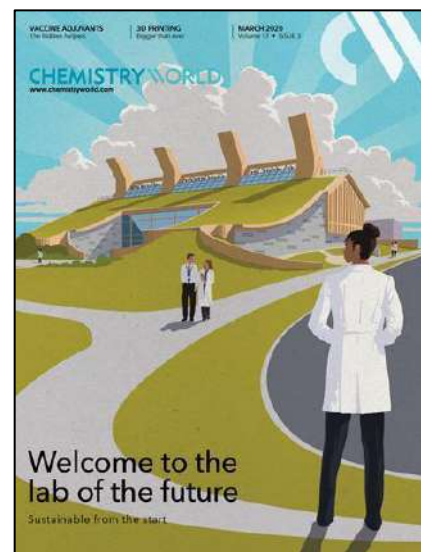
Lab Operations - YOU

- Chemicals, equipment use, etc.
- How staff interact with their facility

Impacts of Science - Life Cycle Analysis

- ▶ Would not promote the replacement of functional models for efficient versions... Why? Because of Embodied Carbon
- ▶ Much data on impacts of science skip this crucial aspect
- ▶ Lot's 'green' initiatives are unsubstantiated, and driven by marketing





University of California - first multi-institutional sustainable laboratory policy:
www.ucop.edu/sustainability/policy-areas/sustainable-operations/index.html

There's a reason we all follow H&S, but don't all implement sustainable practices...



If there was a standard, what might it look like?
How do we know if a lab is “green”?

2050 - UK net zero

2040 - UK funders net zero

2030 - UCL net zero

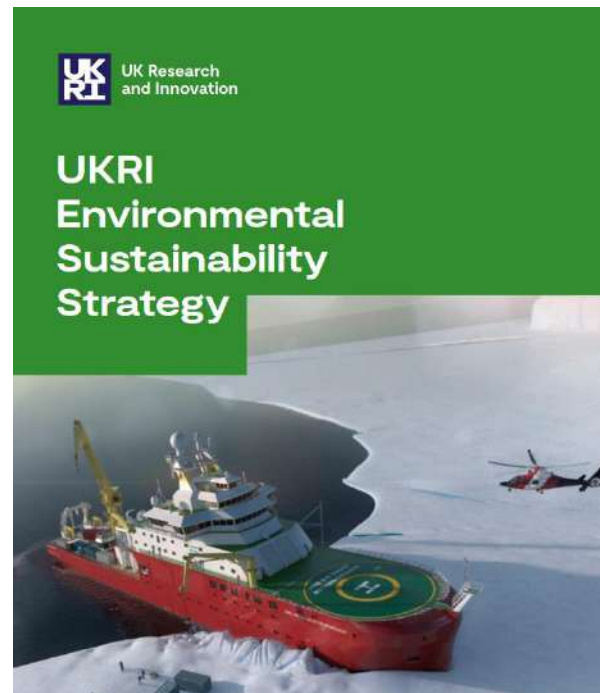
News story

UK becomes first major economy to pass net zero emissions law

New target will require the UK to bring all greenhouse gas emissions to net zero by 2050.

Published 27 June 2019

From: [Department for Business, Energy & Industrial Strategy](#) and [The Rt Hon Chris Skidmore MP](#)



OUR HEADLINE COMMITMENTS FOR 2024:

1. Every student will have the opportunity to study and be involved in sustainability
2. We will increase our sustainability research, with increased focus on the Sustainable Development Goals
3. Our buildings will be net zero carbon, and by 2030 our institution will be net zero carbon
4. Be a single-use-plastic free campus
5. Reduce waste per person by 20%
6. Create 10,000m² of more biodiverse green space on campus

LEAF: Laboratory Efficiency Assessment Framework

- Standard in Sustainable Laboratory Operations
- Criteria in areas like ventilation, equipment, people, facilities/space, procurement & waste, samples & chemicals, and research quality
- Bronze, Silver, Gold categories of criteria
- User-led initiative
- Crucially allows you to estimate impact in CO2 and money saved, with inbuilt calculators



Example Criteria on Reproducibility

- ▶ Calibration of scales and pipettes
- ▶ Providing a forum for the sharing of negative results
- ▶ Ensuring common protocols are centrally shared
- ▶ Promotion of core facilities
- ▶ Potential new criteria: Has the lab sought to make use of existing data? Is this good or might it encourage



LEAF support

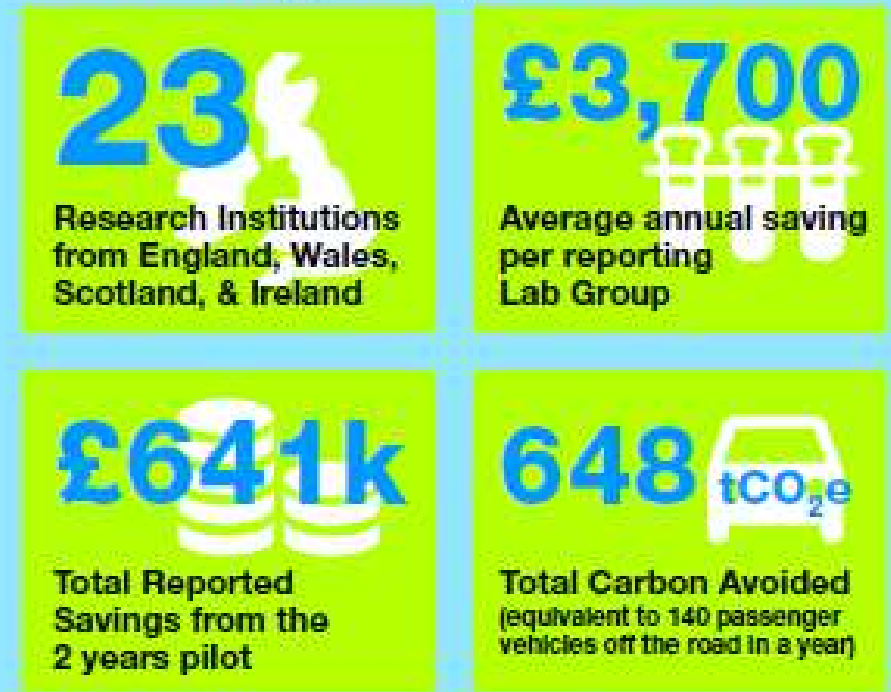
- ▶ LEAF Tool: Contains criteria and calculators
- ▶ Audit guide: Contains information on how to assess each criteria
- ▶ Process guide: How to run a sustainable labs programme
- ▶ Helpful Guides and Support: Linked in throughout LEAF's criteria (posters, inductions, departure docs, etc.)
 - ▶ UCL's Equipment Guide
 - ▶ UCL's Consumables Guide
 - ▶ <https://www.ucl.ac.uk/sustainable/staff/labs/resources-and-materials>



LEAF 2018-2020 Pilot Results

- ▶ 225+ submissions from 23 Institutions (England, Scotland, Ireland, Wales)
- ▶ £3,700 - Average saving per lab / annum
- ▶ 2.9 tCO₂e - Average CO₂ reduction per lab / annum
- ▶ Equivalent of 132 cars taken off the road (620 tonnes of CO₂ equivalent)
- ▶ 52% had used a system before, though 74% said it was driving new good practice and not a validation of the existing
- ▶ 99% said they would participate again

LEAF was piloted 2018-2020 prior to going online
235 Lab Groups took part from...



99% of those surveyed said they would use LEAF again

What's next for LEAF?

- Now available online!
- Bristol became 1st institution in the world to commit to a 100% uptake of a sustainable lab programme, and are using LEAF
- Funders are looking at this area now
- 28 Institutions signed up since going live in February (soft launch)

Pilot Participants included..

- Imperial
- Edinburgh
- Bristol
- Cambridge
- King's College London
- Nottingham
- Cancer Research UK
- Oxford
- BGS
- Cork
- Glasgow



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How Does LEAF Work?

1. Register
2. Choose your level (Bronze, Silver, Gold)
3. Work through the criteria, provide a sentence for each
4. Use Calculators to estimate the impact of your actions *Optional
5. Submit
6. Audits - Depending how your institution

Welcome to LEAF

[Manage Lab](#)

0

The best lab

Welcome to **LEAF** (Laboratory **E**fficiency **A**ssessment **F**ramework), a standard in sustainable laboratory operations.

[Step 1 - Award Criteria](#)[Step 2 - Calculators](#)[Step 3 - Open Initiatives](#)[Step 4 – Review and Submit](#)

How LEAF works

- Address each criteria for the Award Level sought. Each criteria must be addressed for your award level, even if it's to say why it's not applicable. Make sure to save as you go!
- Optionally, you may use the "Calculators", which allow you to estimate your carbon reductions or financial savings.
- Optionally, you may fill in "Open Initiatives", which are initiatives that may not have fit within a criteria but are worth sharing.
- Review and submit your work once complete



Criteria

Supporting Resources

Category - Waste

Description

The lab possesses required waste bins (possibly clinical, glass/sharps, hazardous etc.), as well as recycling/general waste bins with appropriate and clear signage.

Why?

Laboratories produce immense amounts of waste (often plastics), much of which is incinerated at high-temperatures. Reducing the waste produced as well as treatment the waste receives can have significant environmental benefits, as well as reduce associated costs. Clinical waste will cost 3-5 times more than typical waste streams.

How did you meet this?

We now have recycling bins in place. |

Save All Answers

Criteria

Supporting Resources

Tips and Advice

- Unless you work within a specialist laboratory (e.g. CL3), not all materials entering a laboratory are contaminated. Discuss with local H&S what is actually contaminated.
- When introducing new waste streams, always ensure H&S are on board, estates have communicated a method of disposal and cleaners have been consulted, and users have been educated with training materials updated.
- Consider the location and shape of bins for new waste streams. The volume of waste shouldn't vary, only the location/shape of bins.

External Links

[Case study on recycling plastics in tissue culture spaces at KCL](#)


[Bringing recycling into the lab](#)

[UoYork article on lab plastic waste](#)

Local Links

[Watching music](#)

Optionally

 LEAF Admin

Create Open Initiative

Please provide a short description of any noteworthy initiative you've implemented, which may not be captured by the criteria

Initiative Description


We repaired and combined 2 broken centrifuges into a functioning one, instead of purchasing a new one.

Total Savings (£/\$/€) - Please provide approximate savings for the initiative *

2,500

Back

Save

Calculator Name 	Step 01 - Baseline Calculator	Step 02 - Savings Calculator
Waste	View/Edit Calculator	Start Calculator
Biosafety Cabinets	Start Calculator	Start Calculator
Fume Cupboards	Start Calculator	Start Calculator
ULT Freezers	View/Edit Calculator	Start Calculator
-20C Freezers	Start Calculator	Start Calculator
Refrigerators	Start Calculator	Start Calculator
IT	Start Calculator	Start Calculator
Water	Start Calculator	Start Calculator
Equipment	Start Calculator	Start Calculator

How we recommend a start to making your labs more sustainable

- Start 'Green lab groups'
 - See what others are up to before embarking
 - Set some goals (LEAF)
 - Engage the appropriate people *Get Technical Guidance*
 - Estimate impact
 - Share with senior management, your colleagues, everyone! Make them jealous
 - Repeat
-
- Consider continuity of your projects!

Question Standards, and introduce new ones



Dept. of Plant Sciences, Cambridge

Thank you!

@GreenLabGuy
@LEAFinLabs



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<https://www.ucl.ac.uk/sustainable/staff/leaf>

THANK YOU

- Cristina Azevedo, formerly UCL, now InnovPlantProtect CoLab
- Daniela Melandri, UCL
- Sustainable UCL
- RMID, KCL
- UCL ISD, Vindya Dassanayake
- Joanna Marshall-Cook, UCL
- Environment & Energy, Cambridge
- KCL Sustainability
- UoBristol Sustainability
- UK Reproducibility Network
- NTDC
- Martin Howes, UoCambridge
- LEAN (Anna Lewis, Andrew Arnott, and all involved)
- Everyone using LEAF!

- James Parry & Elicia Price
- Everyone that organised this event