Sustainable laboratory research: LEAF and green lab efforts

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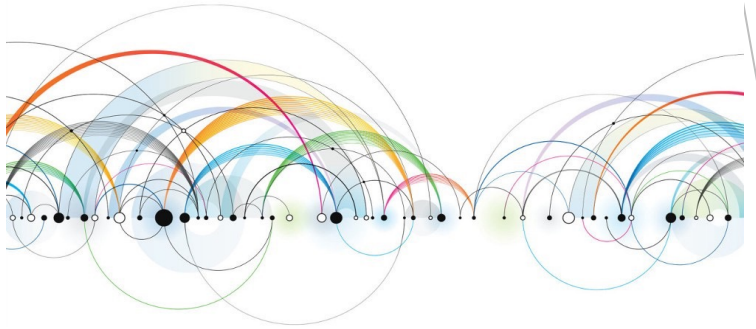
Sustainability in Science – A force for good

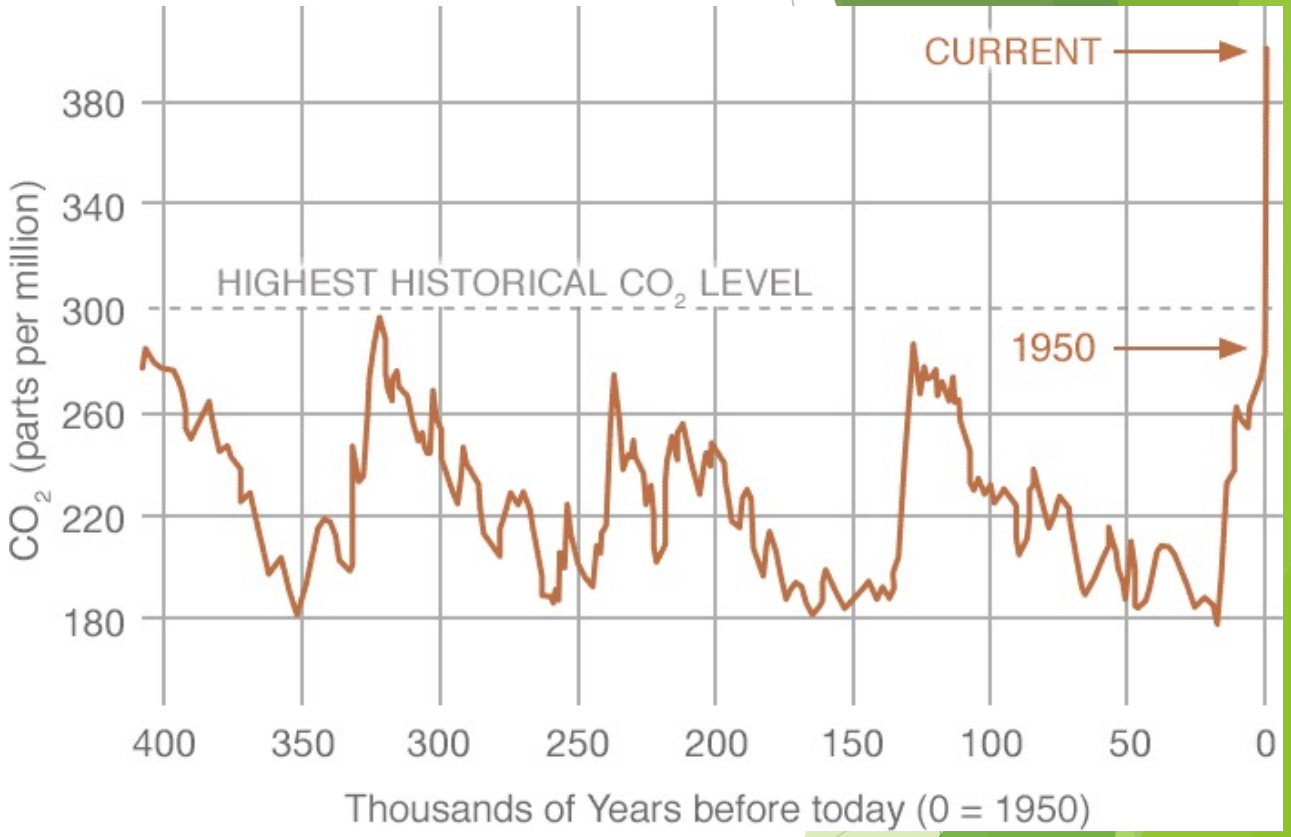
- Plenty of good from science:
  - CRISPR/Cas9 editing
  - Male contraceptives (functional in monkeys thus far)
  - Artificial wombs (for sheep)
  - A new (drowned) continent! Zealandia
  - Most even agree on climate change (concern has risen from 66% to 70% from 2015-2016)[1]
  - 12 billion yr old Oxygen molecule (UCL)
  - Memory transfer to snails
  - Warm blooded fish discovery
  - Addressing Covid-19



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

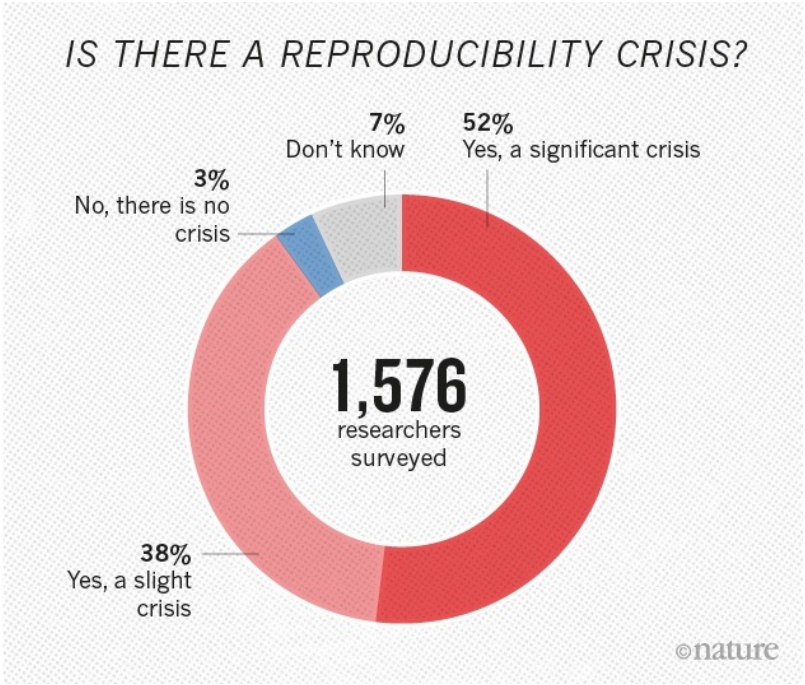
Sustainability in Science

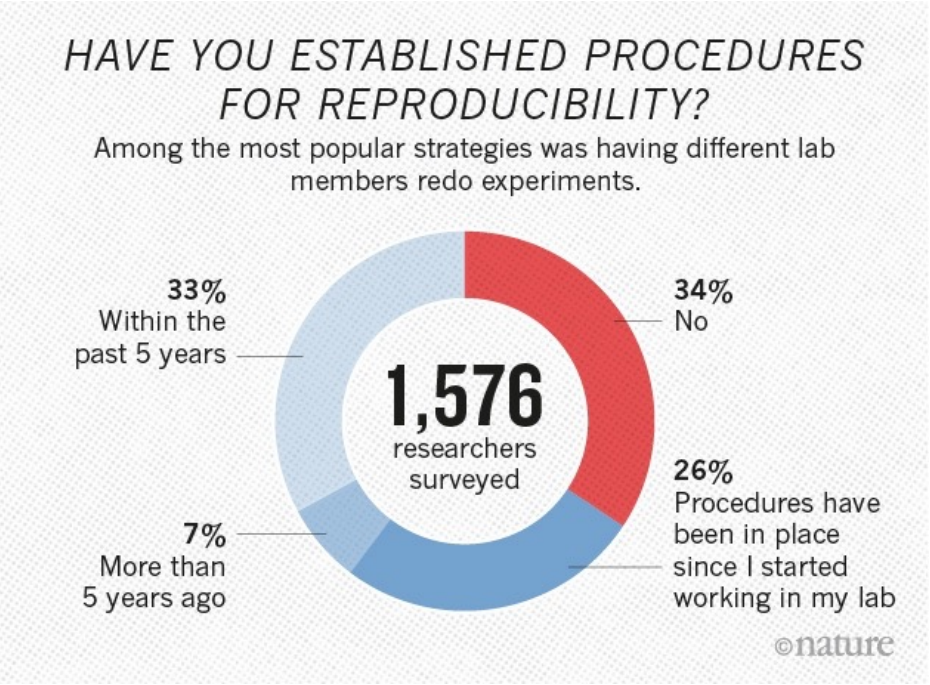
- There are growing numbers of people working in research
- Plenty left to research
- Overall sums of investment are increasing, *but* winning a grant is extremely competitive. More collaboration required
- Increasing interest in the systems of science (data management, quality)



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

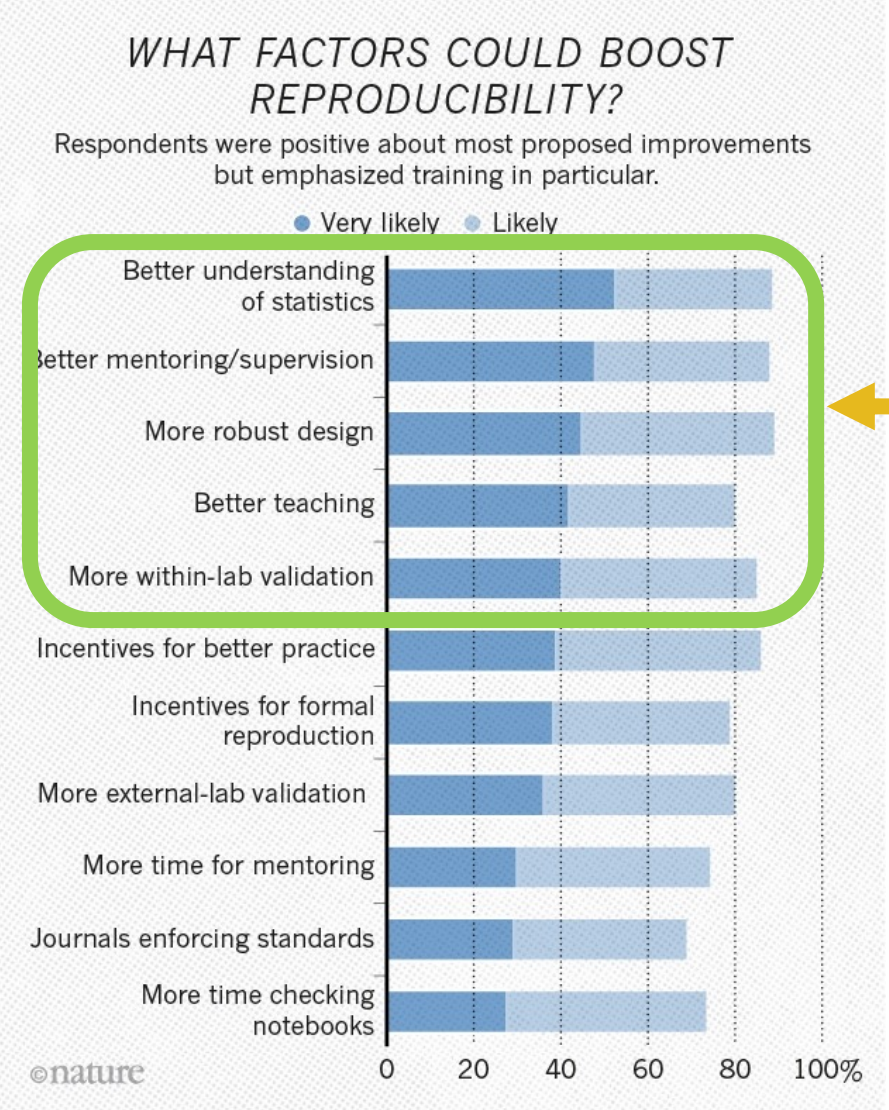
Crisis of Reproducibility





Ref: 1,500 scientists lift the lid on reproducibility – Baker, Nature. 16

Crisis of Reproducibility



Achieved by good laboratory management & procedures

Ref: 1,500 scientists lift the lid on reproducibility – Baker, Nature. 16

- 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

3) 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

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

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

Quiz

5) 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

6) 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%

Source: https://en.unesco.org/node/252279

Quiz

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

a. .001%

b. .1%

c. 0.5%

d. 1%

https://en.unesco.org/node/252277

Quiz

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

2050 – UK net zero

2040 – UK funders net zero

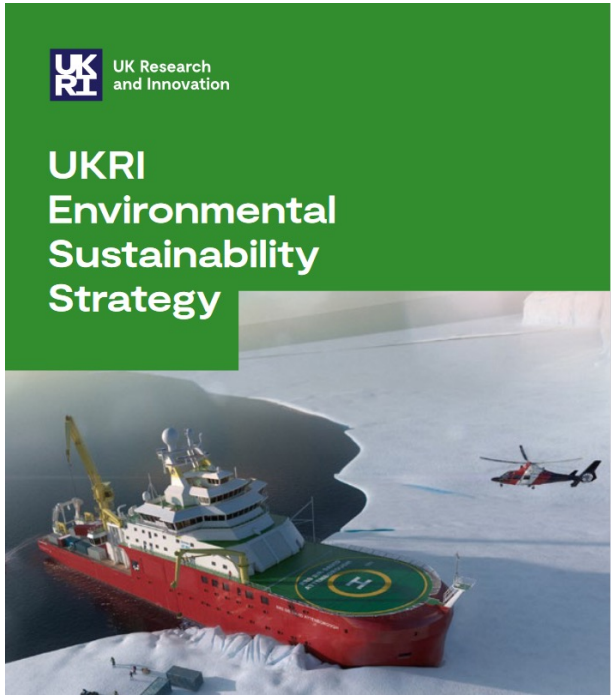
2030 – UCL net zero
2025 – KCL Net Zero

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



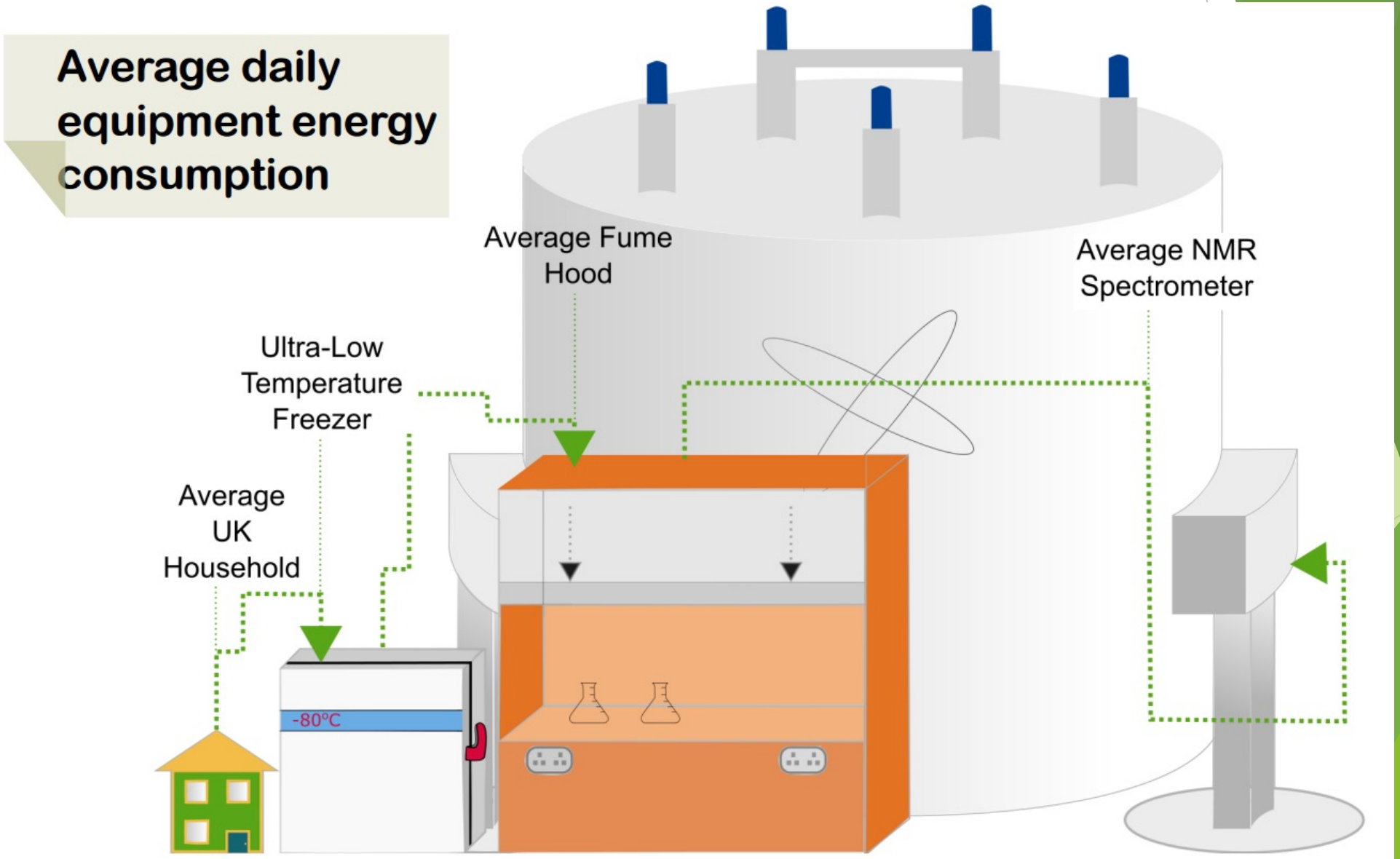
wellcome

NERC SCIENCE OF THE ENVIRONMENT

Laboratories

- Labs consume 3-10 times more energy per m^2 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



Sustainable Labs Today

Green Chemistry

Sustainable / Green Labs

Built Environment

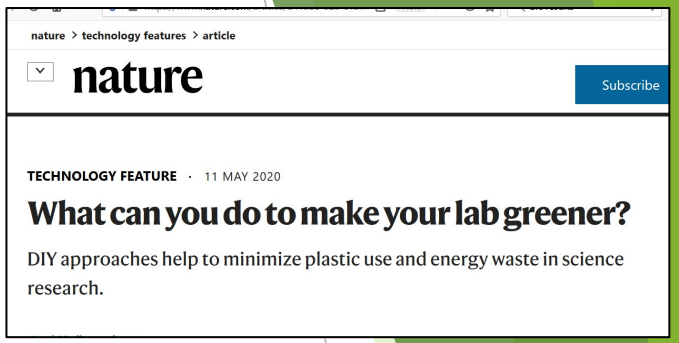
- BREEAM, Passive house labs?
- SKA Labs
- Ventilation Rates
- Net-zero construction

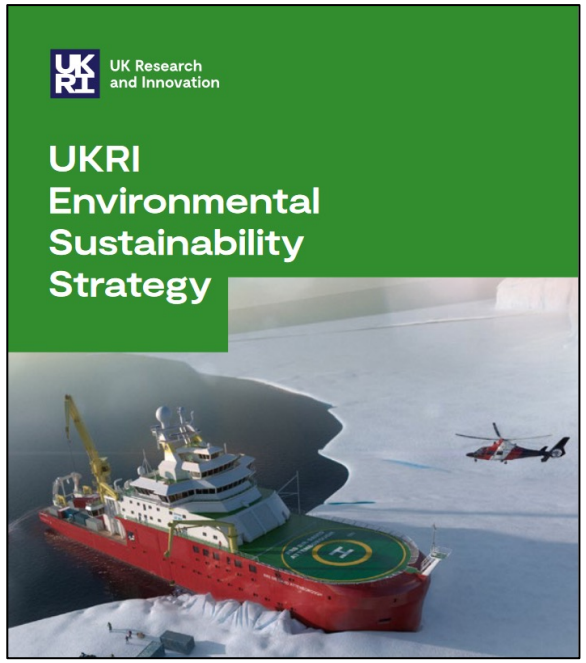
Equipment & Consumables

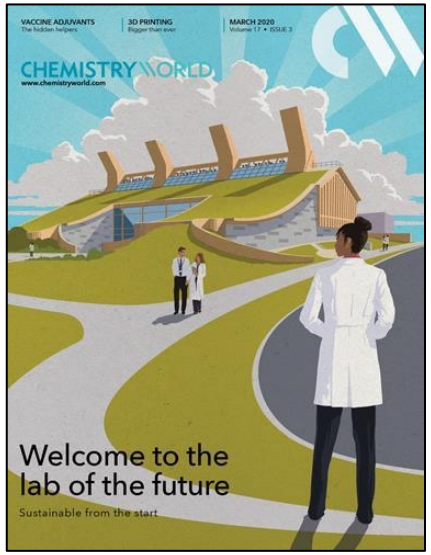
- Sustainable Tenders
- Manufacturers Impact
- NEED Life-cycle carbon assessments

Lab Operations - YOU

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







LEAF
The Laboratory Efficiency Assessment Framework
University of BRISTOL

green lab associates

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

Laboratory Operations – Top Tips

- Close fume cupboard sashes whenever not in use
- Turn off equipment when done, including safety cabinets
- Recycle clean packaging, reduce wherever possible
- Clear out old samples! Maintain cold storage equipment
- Share chemicals and resources, centralize systems
- Reuse, Reuse, Reuse (either plastics or glass)
- Don’t throw away to facilitate moderate efficiencies

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”?

LEAF: Laboratory Efficiency Assessment Framework

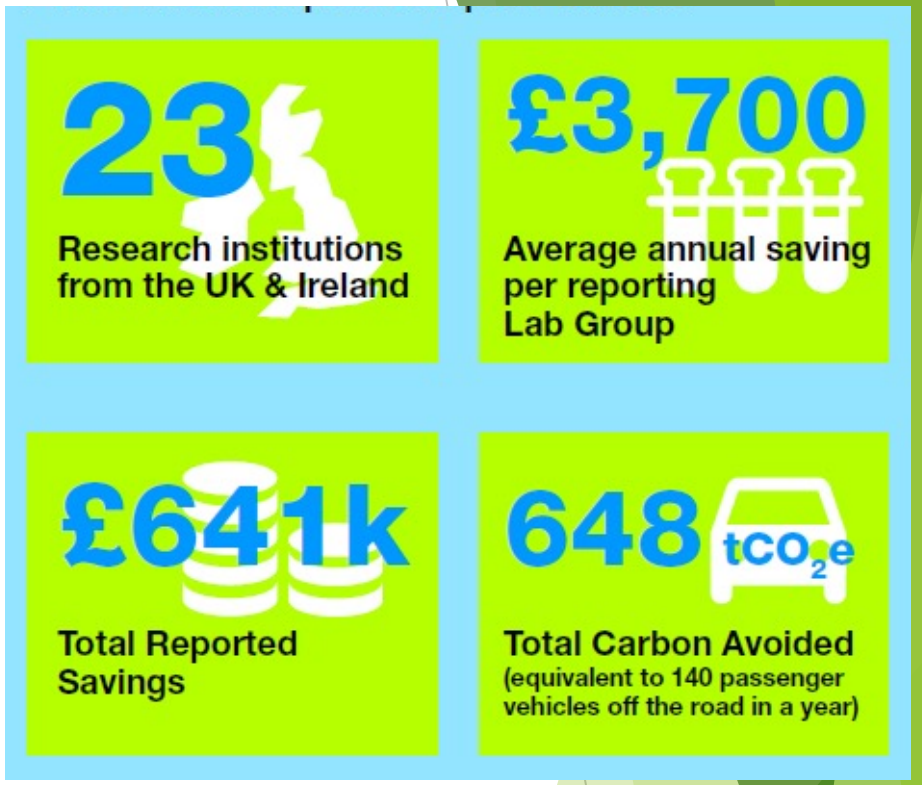
- Standard in Sustainable Laboratory Operations
- Criteria in areas like ventilation, equipment, people, facilities/space, procurement & waste, samples & chemicals, and research quality
- Bronze, Silver, Gold categories of criteria
- User-led initiative, hosted by UCL
- Crucially allows you to estimate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

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

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



Pilot Participants included..

- Imperial
- Edinburgh
- Bristol
- Cambridge
- King's College London
- Nottingham
- Cancer Research UK
- Oxford
- British Geologic Survey

What's next for LEAF?

- Now available online! Expect 40 institutions to be using it by this summer.
- Bristol became 1st institution in the world to commit to a 100% uptake of a sustainable lab programme, and are using LEAF
- Engaging funders on uptake – plenty of initial support

National Technician Development Centre for Higher Education

UK Research and Innovation

Arts & Humanities Research Council · EPSRC · ESRC Economic & Social Research Council · Innovate UK · Research England · BBSRC · MRC Medical Research Council · Science & Technology Facilities Council · NERC Science of the Environment

UKRN

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How we recommend a start to making your labs more sustainable

- Start ‘Green lab groups’
- See what others are up to before embarking *Watch for greenwashing*
- 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… But we need more!

- Understand all sources of possible variation in experimentations

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Thank you!

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THANK YOU
-Jordan Gutherie, KCL
-Oli Austen KCL
-Isma Ali, KCL
-Cristina Azevedo, formerly UCL
-Daniela Melandri, UCL
-Sustainable UCL
-RMID, KCL
-Mukesh Mistry, KCL
-Martin Howes, Cambridge
-Environment & Energy, Cambridge
-KCL Sustainability
-UoBristol Sustainability
-UK Reproducibility Network
-LEAN (Anna Lewis, Andrew Arnott, and all involved)
-Everyone using LEAF!

-BNA organisers
-Drs Charlotte Rae, Anne Urai, Kate Jeffery