University of Strathclyde Glasgow

Sustainable Laboratory Good Practice Guide

This good lab practice guide has been created for members of Strathclyde University that are interested in developing safer, successful and sustainable labs. The guide is composed of best practices covering methods on how to reduce energy consumption and waste in the laboratory environment. The guide represents just a portion of the vast body of knowledge on this topic and does not aim to be comprehensive.

Version

Version	Purpose / Change	Author	Date
1.0	Sustainable Good Lab Policy	R Oun	31/07/2016
1.1	Sustainable Good Lab Policy	R Oun	11/06/2021

Contents

Introduction

The University of Strathclyde is the third largest university in Scotland with 67 buildings and over 500 acres of land. It is one of the largest employers in Glasgow with approximately 3,000 FTE staff members and over 15,000 FTE students. Taking account of distance learning, short course and continuing professional development and evening courses, Strathclyde provides courses for over 50,000 people each year, making it the UK's largest provider of postgraduate and professional education.

The University's Sustainability Policy recognises the social, economic and environmental responsibilities of the University across its activities and outlines the University's commitment to the principles of sustainable development. It also recognises the University's role in the exchange of information and good practice and in stimulating debate with communities over sustainability within and beyond the campus.

As a *place of useful learning* we take it as our responsibility to be of benefit to society and to reach outside the University to make the world better educated, prosperous, healthy, fair and secure.

Vision & Aims

Vision

The University of Strathclyde will provide an opportunity for all students and staff to contribute to the responsible management of sustainable academic and research activities, and to proactively mitigate negative environmental and social impacts.

Aims

The aim of this practice guide is to:

- Promote a positive message to University of Strathclyde students, staff, and partners on the importance of laboratory-based environmental and social responsibility to the University.
- Secure active participation from the University of Strathclyde students, staff, and partners to embed sustainability good practice within day to day business.
- Clarify targets, objectives, and priority areas of activity between to 2016-2020.

The Sustainable Labs Programme

The sustainable labs programme (S-Labs) is an international accreditation award scheme aimed at making labs safer, successful and sustainable. Users will work through an online workbook that consists of eight lab orientated categories; chemicals & materials, waste & recycling, water, energy, fume cupboards, cold storage, energy & equipment, management & training. Each category is broken down into gold, silver and bronze sustainable practice criteria (scaled on difficulty) and will be elaborated on in the following section.

S-labs supports researchers, staff, faculty, and building managers to envision and implement sustainable practices and technologies that increase efficiency, reduce energy use, and conserve resources in lab buildings across the campus. Our goal at Strathclyde University is to emphasize safety, business success and sustainability rather than compartmentalizing and/or seeing them as competing with each other.

Chemicals and Materials

The university has an inventory of tens of thousands of different chemicals. It is important that all labs have an updated list of chemicals available at all time. Some chemicals and materials are environmentally damaging and while a minimisation of their consumption and their correct disposal can have environmental and financial benefit, the substitution of hazardous chemicals for less hazardous ones (when possible) can be of equal importance.

Ref	Lab Criteria	Category	Points

L001	All chemicals are stored in Health and Safety approved locations. A list of controlled substances also exists and is kept up to date.	Bronze	3
L028	The laboratory has created guidelines or communications to ensure chemicals and materials are used efficiently so that waste is minimized.	Bronze	3
L026	All chemical containers are labelled with details of contents, ownership and (where relevant) hazard and emergency details, and the location of those which are hazardous and/or expensive is tracked	Silver	5
L029	The Laboratory has identified and attempted to find alternatives to especially environmentally damaging or hazardous chemicals, e.g. ethidium bromide	Gold	6
L027	The laboratory avoids accumulation of unwanted chemicals by managing stocks and sharing chemicals	Gold	6
L061	Labs have signed up to Quartzy, the free chemical inventory system to keep track of your chemicals	Gold	6

Chemical and Materials Assessment Criteria

CHEMICAL AND MATERIALS GOOD PRACTICE

Good Sample Labelling

It is vital that all samples are labelled correctly and stored in safe and approved locations. Labelling should include name, detail of sample content and an expiry date (this helps users to manage and clean out their chemical stock regularly).

Alternatives to Hazardous Chemicals

Reducing the risks of chemical substances to researchers and the environment can be achieved in various ways. One of these methods involves the substitution of hazardous chemicals with less hazardous alternatives (when applicable). However if the use of toxic chemicals is necessary then it is important to:

- ✓ Provide training to students and staff on how to use the chemical safely
- ✓ Store the chemicals in appropriate locations

Ethidium Bromide Substitutes

Ethidium Bromide is the most widely used DNA stain in molecular biology. However, due to safety and health concerns associated with exposure to this chemical, there has been increased interest in the use of alternative DNA stains that are considered to be safer and can be disposed of down the sink rather than with hazardous waste disposal processes. If you use ethidium bromide for DNA staining consider the use of the following alternatives that are marketed as being superior to ethidium bromide by having a combination of low toxicity, high sensitivity and exceptional stability.

- ✓ 1) Gel Red - http://www.bioscience.co.uk/
- ✓ 2) SYBR® Safe - https://www.thermofisher.com

Sharing Chemicals and Equipment - Quartzy

Quartzy is the world's No.1 online lab management program. It is used by lab academics and pharmaceutical companies worldwide to manage lab inventories, share protocols, track order requests and manage sign-up's for shared equipment.

To create an account and see who else in your department is using quartzy visit:
https://www.quartzy.com/

Waste and Recycling

Strathclyde University is proactive in its commitment to reducing and recycling resources. The strategy for managing laboratory waste aims to maximize health and safety and to minimize its environmental impact. As well as chemical waste, labs create large amounts of solid waste, including: equipment at the end of its useful life, packaging and consumables. Reducing this not only has environmental benefit but can also reduce disposal costs and, in some cases, avoids extra purchases because things can be recycled or reused.

Waste and Recycling Assessment Criteria

Ref	Lab Criteria	Category	Points

L008	There are convenient facilities to enable collection and separation: - Clinical waste (if generated), - Hazardous waste (if generated), Cardboard/paper, - Glass; - Plastics, - Metals.	Bronze	4
L063	Re-useable glass wear (i.e. glass spreaders) is provided in preference to disposable plastic items	Bronze	3
L024	There is no mixing of contaminated with uncontaminated materials/water etc. thereby avoiding the need for the latter to be treated as hazardous or special waste	Silver	6
L039	The laboratory has a system in place to minimise 'hoarding' of unused equipment with no clear future application, and has communicated this to their users within the last 6 months	Silver	6
L040	The laboratory has a procurement contracts which implement collection of empty bottles, packaging etc OR measures are being taken to achieve this	Gold	8

Lab Waste Reduction Tips

- Think of waste minimization from the start when planning work in the lab.
- Reduce the scale of laboratory processes and substitute materials with less hazardous chemicals when possible.
- Check Quartzy before ordering, sometimes the chemicals you need might already be available in your department through another registered principle investigator.
- Order chemicals in small amounts as extra material can end up taking valuable storage space and may become a greater potential hazard which might eventually become a disposal problem.
- Segregate hazardous from non-hazardous waste when practical and safe to do so. This makes economic and environmental sense since it can reduce costs associated with hazardous waste disposal.

For more information on the University of Starthclyde's waste and recycling systems, facilities, procedures and performance targets please visit: www.strath.ac.uk/sustainablestrathclyde/recycling.

Water

During the academic year 2014-2015 Strathclyde University consumed approximately 175,000 m^3 of water and produced an estimated 165,000 m^3 of sewerage. This had a total cost of over £600,000 placing the University as the second highest water consuming higher education institution (HEI) in Glasgow and eighth highest in Scotland. Over 60% of our water usage occurs in laboratory buildings.

Water Use in Labs

Water consumption in laboratory buildings is significant relative to the typical water volumes associated with domestic use, as illustrated in Figure 1. Glass washers, sterilisers, autoclaves, and water condensers all contribute to significant water consumption. Thus it is important to find alternative water efficient replacements for these equipment.

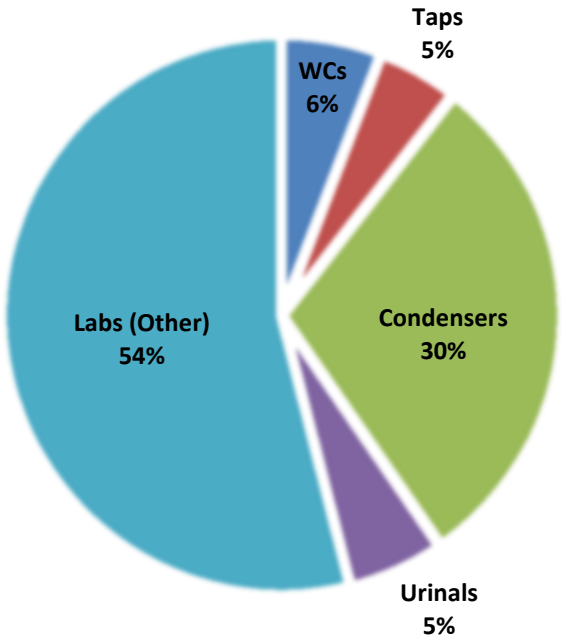


Figure 1 - Water Consumption at the Thomas Graham building.

Water Assessment Criteria

Ref	Lab Criteria	Category	Points
L009	The laboratory has raised awareness of the related cost and environmental issues of considerable water use amongst laboratory users and has communicated policies and guidance on efficient usage practices.	Bronze	4
L025	Water for cooling is recirculated rather than running continuously to waste.	Silver	6
L041	Water-using equipment is 'right sized' for tasks and used with as high loadings as possible	Silver	6
L010	Water is used efficiently for cleaning and rinsing	Silver	4
L023	Purified water is used only when absolutely essential, and produced by reverse osmosis (RO) wherever possible	Gold	8

Waterless Condensers

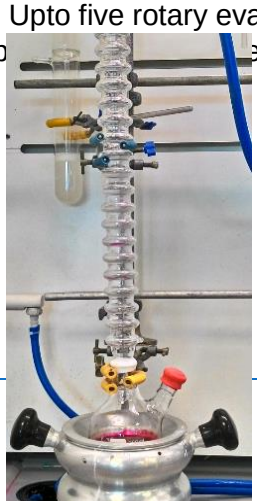
Waterless condensers are unique glass condensers that require no water for operation (Figure 2). They can be used with most solvents and used in the same manner as water-cooled condensers (check our water condenser guide poster). They are economical and should be used whenever possible. The significant benefits of using waterless condensers include:

- ✓ Completely omit the need of water
- ✓ Save money on water usage
- ✓ No risk of flooding

As part of the sustainable labs scheme we are exchanging water condensers for waterless condensers across campus. For more information please contact Rabbab.oun@strath.ac.uk.

Unichillers

Water unichillers (Figure 2) are unique equipment that can substantially reduce water wastage. Compared to conventional tap water cooling chillers offer higher rates of efficiency, stable pressure and flow rates. They reduce water consumption, making them an environmentally friendly refrigeration solution with low running cost. Unichillers in laboratories are often used with rotary evaporator systems. Upto five rotary evaporators can be attached to one unichiller (depending on the model) in which tap



Energy

Our laboratories are the most energy intensive aspects of our operations at the university. Figure 3 illustrates the relative energy intensity of laboratory space relative to standard teaching space on campus. Our aim is to minimize energy and water to reduce waste without compromising research opportunity, output or quality. As will be illustrated in the following sections there is plenty of opportunity to make big reductions in regards to campus energy demand in our labs.

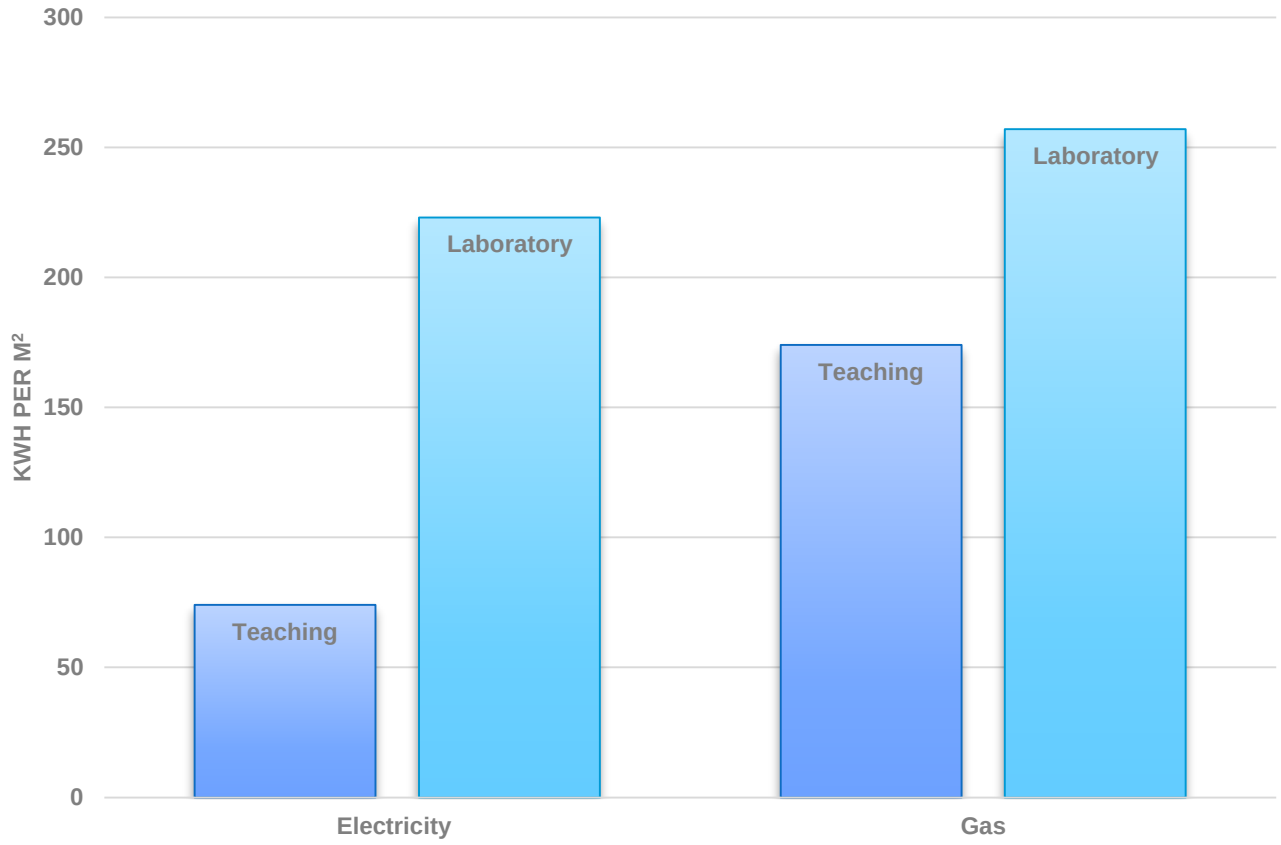


Figure 3 – Laboratory Energy Performance Relative to Teaching Space.

Demonstrating well managed resources within labs, and highlighting sustainable operations, are increasingly a significant benefit when applying for competitive research funding.

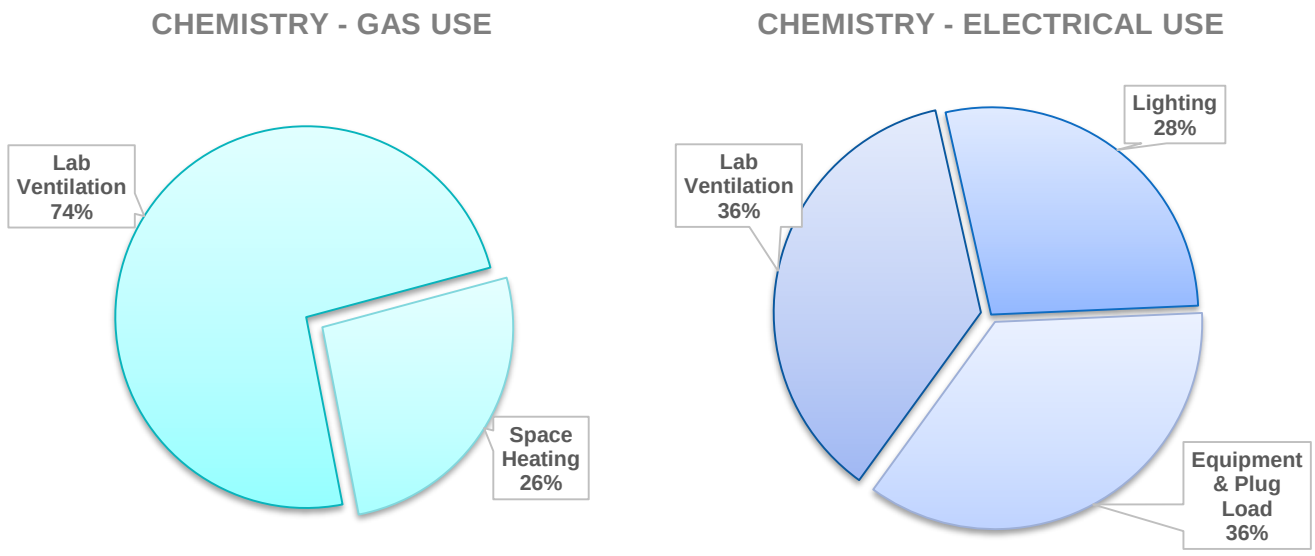


Figure 4 – PAC Energy Breakdown

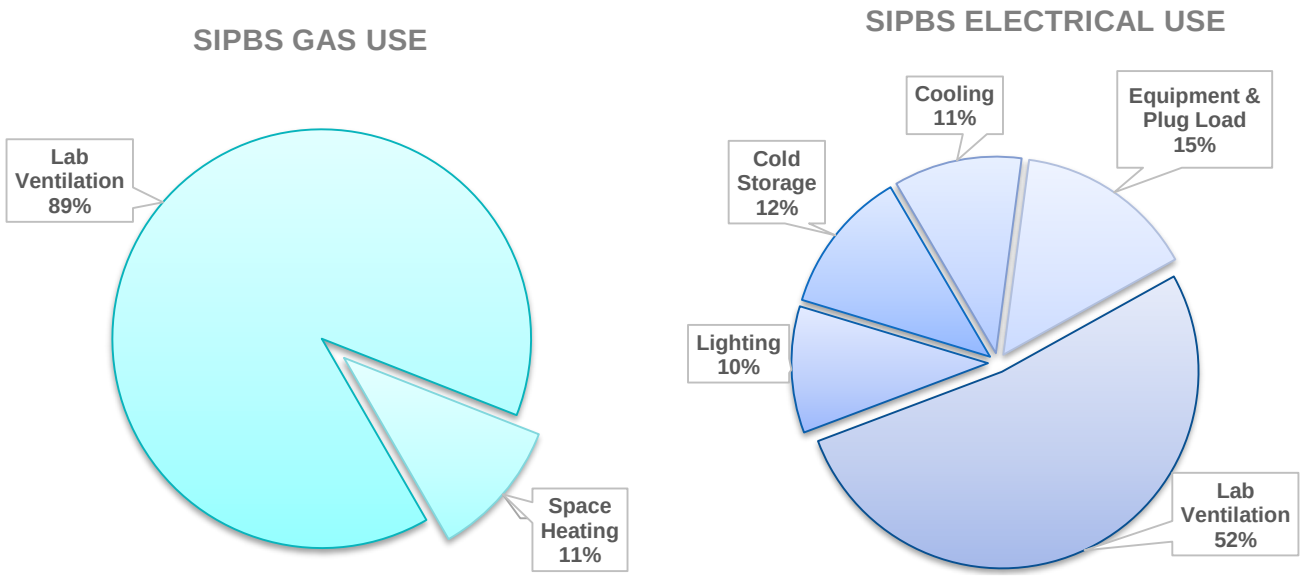


Figure 5 – SIPBS Energy Breakdown

Fume Cupboards

Laboratory fume cupboards are a type of ventilation system designed to capture and remove air-borne hazardous substances e.g. gases, vapours, aerosols and dust generated during an experiment. The fume cupboard sashes serve as a physical barrier between the experiment and the user, offering a measure of protection against inhalation, exposure, chemical spills and fires. It is essential that all fume cupboard users take the time to understand how to use their fume hood effectively, including proper set up, safe operation, and any required maintenance. Fume cupboards should be inspected and tested by competent persons.

Figures 4 and 5 illustrate clearly that fume cupboards make up the majority of energy use in laboratories, both electrically and thermally. They should be operated responsibly to ensure energy waste is minimized. A fume cupboard running continuously with its sash fully open can cost £1,500 in electricity and gas annually. The energy use of a single fume cupboard is equivalent to that of three households over a single year. In spaces with multiple fume cupboards the operating cost can be very high. By operating fume cupboards according to our good practice guide annual operating costs can be reduced dramatically to less than £300-500 p.a.

Fume Cupboard Assessment Criteria

Ref	Lab Criteria	Category	Points
L003	The lab has effective communications in place to encourage energy efficient use of fume cupboards	Bronze	3
L004	The lab complies with the spirit as well as the letter of COSSH regulation 9 which requires that fume cupboards are “maintained in an efficient state, in efficient working order, in good repair and in a clean condition	Bronze	3
L019	All fume cupboard sashes are down when no one is using them, especially at night and/or over weekend.	Silver	7
L014	Fume cupboards are not used as storage cupboards for prolonged periods (i.e. longer than the length of the experiment).	Gold	8

9.2 Fume Cupboard Considerations

Face Velocity

The ‘face velocity’ is the velocity of the air moving across the front plane of the fume cupboard. Modern fume cupboards, and the majority of fume cupboards at the university, are designed to maintain a face velocity of 0.3m/s. Some of the older fume cupboards are set at 0.5 m/s.

Extract Type

Two types of fume cupboard supply and extract ventilation systems are used across the university; constant air volume (CAV) and variable air volume (VAV). In a constant air volume (CAV) system the extract fans operate at a fixed speed, extracting air at a constant volume. Variable air volume (VAV) systems are designed to modulate the extract fan speed relative to the sash position on the fume cupboard, maintaining a constant face velocity. When the sash is fully opened the volume of air extracted through the fume cupboard is the same as a constant air volume system, however when the sash is lowered the amount of air extracted through the fume cupboard is significantly reduced.

Fume Cupboard Sashes

Fume cupboard sashes can be defined as an adjustable screen between the operator and the work space. The purpose of the sash includes:

- Containment of fumes/vapors/gasses/powders that may potentially be toxic, thereby limiting their direct exposure to lab members.
- To impose a minimum impedance on the ergonomically efficient and effective use of the fume cupboard.
- To minimize energy demands while remaining consistent with the needs of containment and purge, this target being increasingly associated with the use of Variable Air Volume. However, none of these operational objectives can be met if sashes are left routinely open when fume cupboards are not in direct use.

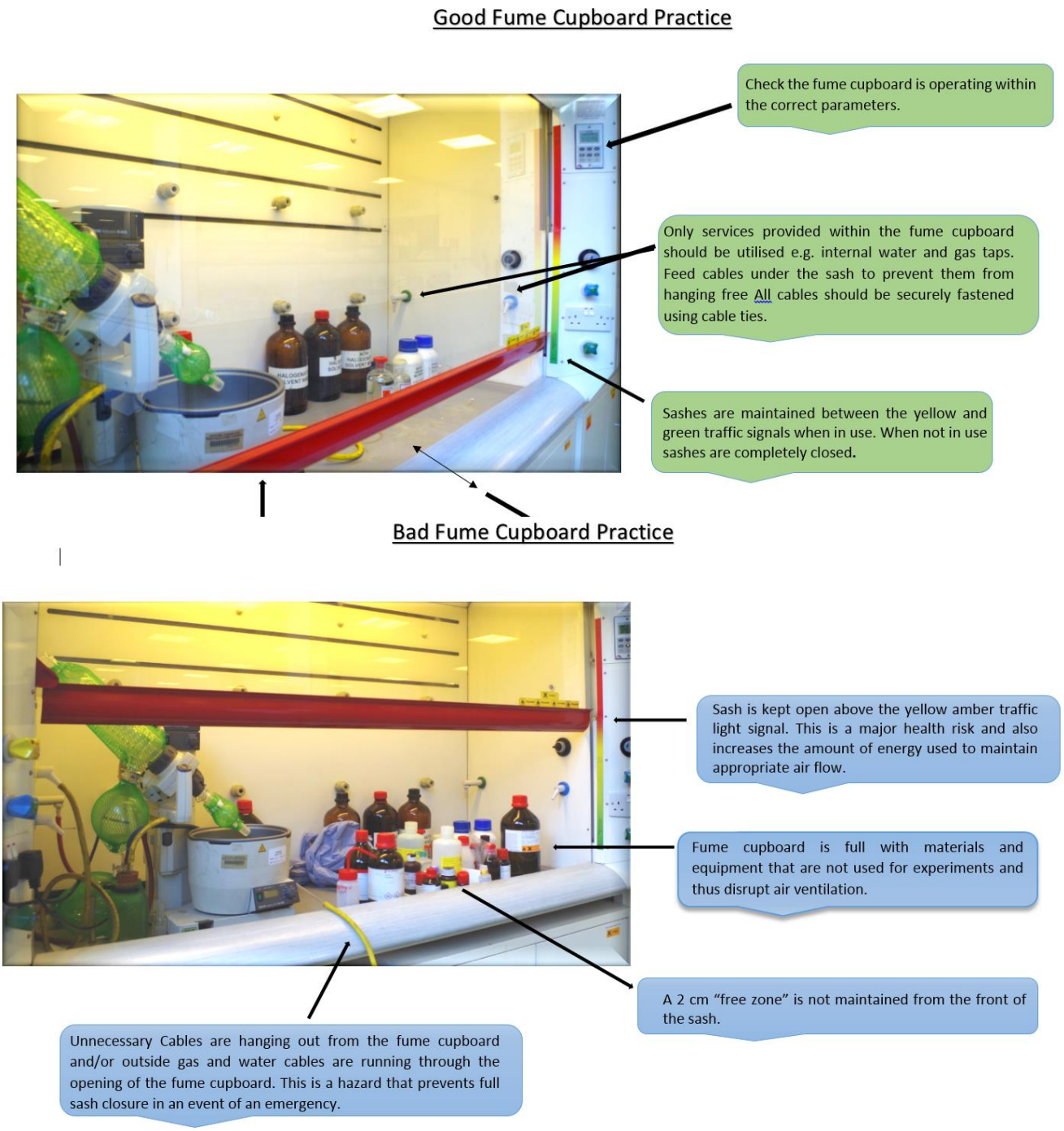
Fume Cupboard Best Practice

They following fume cupboard operating policies should be put in practice at all times. These policies are designed to improve user safety and reduce energy waste. Figure 7 demonstrates good fume cupboard practice compared to bad fume cupboard practice.

Shut the sash completely when the fume cupboard is not in use.	A fully open sash is ineffective against explosions, reduces the efficiency of fume extraction; and increases energy consumption. Keep the sash as low as safely possible.
Use the right sash height (≤ 0.5 m)	The sash is designed to protect users against explosions and contaminants. Keep the sash as low as safely possible. Never raise the sash above the manufactures upper safety catch. Under NO circumstances should an experiment require an operator to position their head inside the fume cupboard.
A 150 mm wide free-zone must be maintained behind the sash at ALL times.	Contaminants released near the sash are at increased risk of being drawn out of the cupboard. It is important to maintain undisturbed airflow in the fume cupboard, which may be caused by poorly placed equipment or operator movements. Overcrowding with equipment and reagents can cause turbulence which can block the air flow and result in a reduction in fume cupboard efficiency.
A 'free air flow zone' must be maintained on the external approach to the fume cupboard at ALL times.	It is important to maintain undisturbed airflow *into* the fume cupboard to ensure effective airflow and safe containment. Hanging lab coats on gas taps, or overcrowding the outside of the fume cupboard with equipment, causes turbulence and results in reduced fume cupboard efficiency.
Appropriate face velocity should be maintained.	Check your manufacturer guidelines; fume cupboards are typically designed to maintain either 0.3 m/s or 0.5 m/s 'face velocity'. Large face velocities are NOT always better; excessively high air velocity (>0.7 m/s) can induce turbulence, decreasing containment. Report excessively high or low inflows to the lab technician.
Avoid using fume cupboards to store chemicals and unnecessary equipment.	Use a dedicated ventilated storage area for chemicals, if required.
Ensure gas and water connections are safe, well made and managed.	All hoses MUST brought into the fume cupboard must be directed UNDER the sill and secured safely. It is recommended they be brought neatly to the side of the fume cupboard. All hose arrangements must allow that the sash to be shut completely.

Figure 6. Image of "shut the sash" traffic signal poster placed on fume cupboards around campus.

Figure 7. An illustration of good vs bad fume cupboard practice.



Cold Storage

Cold storage devices such as fridges and freezers are one of the highest laboratory energy consumers. They directly account for up to 15% of total laboratory energy consumption. Also significant is the indirect energy consumption associated with heat generation, which requires an increase in mechanical cooling and ventilation in the building. It is important these cooling and ventilation impacts are considered when placing cold storage devices. The energy consumption of cold storage devices rises when circuits or interiors are frosted, or not working effectively. Regular defrosting and maintenance is important.

Cold Storage Assessment Criteria

Ref	Lab Criteria	Category	Points
L002	If cold storage is used, all available space is utilised through appropriate racking.	Bronze	2
L014	The laboratory ensures all stored materials are permanently labelled with details of contents, expiry and ownership.	Silver	5
L015	There is regular (at least annual) cleaning, defrosting and (for ultracold freezers) maintenance of devices. This includes cleaning heat exchange coils on fridges and freezers, and defrosting any devices without auto-defrost	Silver	5
L016	All cold storage devices containing important samples or materials have had a risk assessment, and appropriate security measures have been taken to mitigate any risks identified	Silver	7
L030	Within the last 12 months energy costs of cold storage devices have been quantified and incorporated into a whole lifecycle costing approach to new purchases	Gold	8
L060	Cold store facilities should have an inventory located within easy reach. This should include reference to the length that any individual item should be stored to (i.e. to the end of the experiment/PhD/funding window). Annual stock checks of the cabinets should be evidenced to demonstrate that items are not stored beyond their specified date.	Gold	8

Best Practices for Cold Storage

Cold Storage Labelling

It is important that only wanted samples are stored (thereby reducing the overall amount of cold storage required) and that these samples are correctly labelled.

Defrosting tips

- ✓ We recommend defrosting the entire freezer at least once a year.
- ✓ Defrosting is a multistep, manual process. First, remove all samples from the freezer and transfer them to another freezer. The transferring of samples should be done in small batches, because if the door is kept open for too long, you will warm up the freezer prematurely. After all the samples have been removed, turn the freezer off, unplug it, open the door and let the ice melt. Make sure to place towels on the floor to soak up the water, or routinely wipe up the melted ice.
- ✓ Take the opportunity during your annual defrost cycle to evaluate what samples you're storing. It is okay to get rid of samples that are not labeled, have expired or belonged to researchers who left years ago. This will open room for other, more important samples and make them easier to find.
- ✓ Post a freezer map and inventory on the door of the freezer to keep samples organized and minimize the amount of time needed to find a sample:
- ✓ Minimizing the amount of time the freezer door is open reduces temperature fluctuations within the unit, saves time, and saves energy.

Racking Systems

- ✓ Many freezers are configured with compartments that help prevent the buildup of ice.
- ✓ These compartments help segment researcher's samples to make them easier to find, decreasing time in and out of the freezer and minimizing cold air loss.
- ✓ Some manufacturers add gaskets on their inner doors to prevent even more cold air from being lost during door opening; this also aids in the freezer's overall performance.

Responsible Freezer Purchasing

Avoid purchasing a new freezer if possible (check out our - 80 °C freezer study). Can you clean out space in your existing unit to accommodate new samples, or share freezer space with a neighboring lab? This is a great way to save your lab money, and minimize your environmental impact. If a new freezer is necessary, look for an efficient model: Look for energy consumption information on the product's technical specifications. Many manufacturers are realizing that energy efficiency is an increasing area of concern for consumers, and are therefore making strides to ensure their products are as efficient as possible. Larger freezers typically use more energy than smaller freezers relative to their size.

SCIENTIFIC EQUIPMENT

"In the academic year 2014-2015 Strathclyde University consumed 41,665,515 kWh of electricity which totals to just over £4,000,000". Scientific equipment can contribute to a significantly high proportion of laboratory energy and water consumption. Some equipment are kept turned on even when not used or needed, which wastes significant amounts of energy. In other situations some equipment are left turned on because of the need for careful calibration or ventilation. Often equipment is left turned on because lab users and technicians are not sure whether the equipment is about to be used or can be switched off or requires special procedure to switch off. Energy, water and waste

costs can make a significant contribution to the whole life costs of equipment – in some cases more than the initial purchase costs. If these costs are taken into account at procurement stage, it may be more cost effective to purchase more resource efficient but higher first cost equipment at the outset.

Scientific Equipment Assessment Criteria

Ref	Lab Criteria	Category	Points
L007	All equipment that can be is turned off or powered down when not in use, together with related devices (e.g. AC/DC converters).	Bronze	4
L023	The laboratory supports and participates in mechanisms which allow surplus lab equipment to be reused by, or shared between, different teams/labs where appropriate.	Silver	6
L036	Energy, water and waste issues and costs (including any secondary costs such as increased room cooling) are explicitly considered when purchasing lab equipment.	Silver	7
L037	The laboratory undertakes regular (at least annual), and documented, checking and servicing of large equipment.	Gold	8
L038	All energy-intensive equipment is ‘right sized’ for tasks and used with as high loadings as possible.	Gold	8

Use of Equipment Good Practice

Below are a list of best practices that can help reduce energy usage of lab equipment.

- ✓ Switch of equipment that is not needed – Often it is the case that lab users are not aware of what equipment can be switched off. Stickers and posters can help raise awareness of what to turn off and what must remain turned on. It's also helpful to have someone within the lab assigned responsibility for making sure equipment is turned off by the end of the day.
- ✓ Keep equipment regularly maintained – this makes sure that the equipment is running efficiently in terms of energy consumption.
- ✓ Run equipment at high loadings – This helps reduce the amount of time an equipment needs to run and thus saving money.
- ✓ Share equipment between labs – S-Lab has found many examples of equipment duplication between different research groups within the same building. Sharing equipment can save costs, space and reduce waste from ultimate disposal of the equipment, this is something that is now being strongly encouraged by funding bodies such as Research Councils.
- ✓ Purchase energy efficient data – An S-Lab energy audit has shown that lab equipment and IT can contribute to up to 25% of total lab energy use

Figure 8. A range of stickers to help lab users know which equipment should be turned off and which should be kept on.

Energy usage of Scientific Equipment

In the past year we have measured the energy consumption of various lab equipment to raise awareness of their daily/weekly/monthly cost. The table below summarises the cost of running some common lab equipment.

Equipment	Typical Usage (hr/week)	Typical Usage (hr/year)	Equipment Quantity in Building	Estimated Energy Use (kWh/yr)	Estimated Total Costs (£/yr)
Drying oven	168	8400	25	1,932	4,106
Rotary Evaporator	20	1000	36	216	662
Cold Storage	168	8736	26	1,005	2,220
HPLC	40	2000	8	690	469
Hotplate Stirrers	20	1000	107	58	523
Oil Vaccum Pump	40	2000	28	1,380	3,284
IT Equipment	168	8400	43	966	3,531
Ultrasonic Bath	10	500	12	58	59
Hot Air Guns	5	250	10	230	196

Figure 9: Image showing a DrySyn heat block in use along with a condensyn air condenser. DrySyn blocks fit various sizes of round bottom flasks. They eliminate the need of oil and silicon buy in as well as their waste. Furthermore, it takes less energy to heat up a DrySyn block compared to an oil bath to the same temperature. For more info check out our guidelines and benefits booklet.

Management and Training

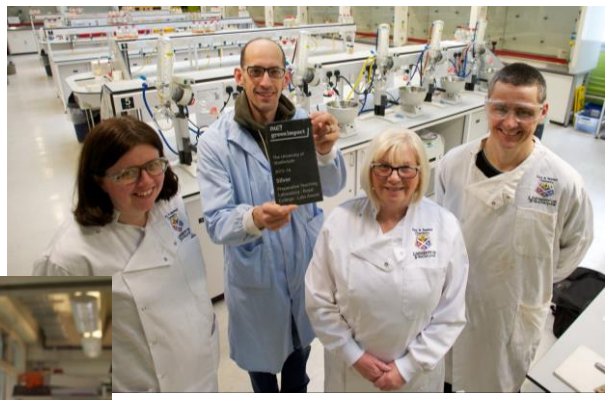
Many actions to improve laboratory environmental performance require approval or active support by academics, and some may also have short-term costs (recompensed by medium-long term benefits). Senior management backing is obviously important in both cases. S-Lab cases and other materials can provide useful evidence to persuade senior managers of the benefits and feasibility of taking action. Often, things are not done because no-one takes responsibility for them.

Management and Training Assessment Criteria

Ref	Lab Criteria	Category	Points
L006	All laboratory users are made aware of the energy and environmental impacts of their activities and the actions they can take to mitigate them. This may include: - Displaying/communicating quantitative impacts of energy, water, waste etc, - Awareness stickers/campaigns;	Bronze	3
L021	The laboratory has, or is connected to, a responsibility structure for key aspects of environmental performance, e.g. a responsibility plan for sash closure, shutdown procedures.	Silver	7
L022	Every new member of the laboratory receives some form of induction that includes content on resource efficiency and good environmental practice.	Silver	7
L034	The laboratory participates in broader networks (within the institution or beyond it) which provide opportunities to discuss and take action on environmental issue	Silver	7
L035	Every postgraduate and staff member departing the laboratory follows a formal exit process covering storage and disposal of all the chemicals, equipment, materials and samples that they have used in their work.	Gold	8

S-Labs Award Ceremonies

An annual Sustainable Labs Award Ceremony is held to recognize and congratulate our sustainable teams. This is a half day event supported by the Executive Dean of Faculty of Science, Professor David Littlejohn.This is an excellent networking opportunity with tasty sustainable meals provided.



14.0 Sustainable Labs PhD Credit Course

In 2017, a novel Sustainable Labs PhD credit course was launched and implemented as part of our PhD researcher professional development programme. We are the first and only UK institution to provide such a course to highlight lab-based sustainability issues to all postgraduate lab-based students. The aim and significance of the course is to give students a deeper perspective of their own personal research related impact on the environment and to find ways to mitigate these. Over 2017-2020 have seen a significant increase in the number of students who uptake this course, from 7 to 13 to 20.

The course is divided into two parts; first, an introductory lecture on S-labs which covers the fundamentals of S-labs and introduces students to the S-labs assessment Framework which they must complete. Through this, student's gain access to our 50% S-Lab initiative fund in which they can exchange old inefficient equipment for newer sustainable ones where the department pays 50% and the sustainability team pay the remainder 50%. Second, students are provided with the opportunity for them to carry out an assessment of their own research environment and contribute suggestions on reducing harmful impacts and improving the safety and sustainability of research activity. In this workshop, students are provided with energy monitors with which they monitor the energy requirements of their lab equipment so they become aware of energy intensive vs less energy intensive equipment. By the end of a working week, students will calculate how much they have spent in energy and water and report it back to the class. For the workshop students also had to complete an essay on what unsustainable equipment and protocols were in place in their laboratories and what would need to be put in place to amend this. They had to ascertain if they, their supervisor or another body had to put improvements in place and how this could be achieved

Once students complete the course they receive credits which is essential for them to accumulate to complete their PhD degrees.

15.0 Resources

Laboratory resources can be downloaded from the Sustainable Strathclyde 'Sustainable Labs' website. These include posters, lab exit forms, incentive fund applications, condensyn forms, fume cupboard traffic signals, switch off stickers as well as case studies.

Sustainable Labs website:
https://www.strath.ac.uk/sustainablestrathclyde/getinvolved/sustainablelabs/

Alternatively you can get in touch directly with our Sustainable labs Co-ordinator:
Rabbab.Oun@strath.ac.uk.

Laboratory Exit Form

Student and Supervisor Information

Student Name: …….. Email: ……

Building: ……..... Lab No(s) ……..

Supervisor: ……... Date Lab vacated: ……..

Nature of employment (tick box): ☐ Post Doc ☐ PhD student ☐ Masters student ☐ Visiting Student ☐ Visiting Researcher

Laboratory Clear Out Check List

- When a student is vacating a lab it is the responsibility of both the student and the student's supervisor to leave the lab in a state suitable for re-occupancy.

- It is the responsibility of the researcher to ensure that all sample disposal is managed safely and appropriately as per the health and safety and the hazardous waste procedures set out by the department

Actions	Yes	No	NA
All personal samples stored on bench tops and cupboards have been cleared out and disposed of correctly.			
All personal samples stored in cold storage facilities (e.g. fridges/freezers/liquid nitrogen cryo-vaults) have been cleared out and disposed of correctly.			
All glassware that were in use have been washed/decontaminated/autoclaved.			
Samples that have not been disposed are now under full authority of the supervisor.			

Certification:

By my signature, I certify that the information provided is accurate.

Lab User Signature …… Date ……

Supervisor Signature ……. ……

Waterless Condenser Form

To claim a waterless Condenser please fill out the section below and email it to Rabbab.oun@strath.ac.uk

Personal Information:

Name: …….. Email: ……..……

Building: …… Lab No: ……..

Condenser Requirements: (tick where appropriate)

- **Large Condenser (450 mm)**

Quantity: …….

Socket Size: ☐ B19 (-) ☐ B24 (-) ☐ B29 (-)

- **Small Condenser (350 mm)**

Quantity: ……..

Socket Size: ☐ B19 (-) ☐ B24 (-) ☐ B29 (-)

- **Mini Condenser (200 mm)**

Quantity …….

Socket Size: ☐ B19 (-) ☐ B24 (-) ☐ B29 (-)

Old Condenser Information: -

Quantity of condensers handed over: ……

Water Volume of Condenser: ……..

All Condensers have been washed and decontaminated: ☐ Yes ☐ No

Certification

By my signature, I certify that the information provided is accurate.

Lab User Signature …… Date: ……

Supervisor Signature …….. Date: ……..