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INTRODUCTION

The Liverpool School of Tropical Medicine (LSTM) is an internationally recognised centre of excellence for research in tropical diseases and has been at the forefront of research into infectious, debilitating and disabling diseases since 1898. Though the School's research is carried out across many domains, much of our research is laboratory (lab) based, with many of our staff working within one of the six labs on the LSTM campus. These lab spaces across the school range from classrooms and small labs to large medical research facilities.

Many of our laboratories contain advanced technology with equipment often consuming considerable energy while additionally requiring multiple sources of water and natural gas. Furthermore, due to the nature of our work, our labs must maintain the highest operational and safety standards, necessitating excellent waste management. Although our labs will likely continue to require both high energy consumption and waste production in the coming years, there are steps which can be taken to refine our practices to bring about impactful reductions.

While there is little doubt that drastically reducing global emissions is both essential and urgent for the long-term health of our planet and its inhabitants, the introduction of more environmentally conscious practices will have immediate benefits for us all today.

Environmental and sustainable practices can often be operationally cost-saving, and the health and planetary benefits of such a transition are essential and urgent. We are now in no doubt the extent of human-caused climate change [COP26 Special Report on Climate Change and Health]. Inaction risks climate disaster, increasing the frequency and severity of natural disasters such as flooding, forest fires, and hurricanes, which disproportionately harm the planet's most vulnerable.

This guide and associated resources have been developed specifically for LSTM faculty, staff, and students on the Liverpool campus. Its aim is to provide actionable points and clear guidance on how we can incorporate environmental and sustainable procedures and behaviours into our occupational laboratory setting to address this urgent matter of climate change.



LABORATORY WASTE

With thanks to Steve Hall, Jeremy Gould and Selina Keaveney for their inputs

Disposal of laboratory waste & recycling

At LSTM, we are proud that all non-hazardous general waste (black and green bins) is deemed to be recyclable and is processed by a Materials Recovery Facility in Manchester operated by our current waste services provider SUEZ. Approximately 65% of our monthly waste is thereby sorted into recyclable fractions. The remaining 35% is taken to a renewable fuels Energy from Waste (EfW) plant at West Houghton where it is incinerated with energy recovery. However, all lab waste that has been contaminated with biohazardous material must be disposed of in the allocated red or yellow bins, as it cannot be recycled and must ultimately be incinerated. Equally, chemicals which are cytotoxic, such as ethidium bromide, are trapped in charcoal or equivalent before processing in the same way. Other liquid or solid chemicals are processed through our chemical waste stream and are taken off site by our contractor, Avanti, who use energy reclamation in their incineration process. This process ensures that LSTM achieves a zero waste to landfill policy.

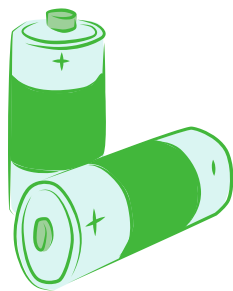


**THIS PROCESS ENSURES THAT
LSTM ACHIEVES A ZERO WASTE
TO LANDFILL POLICY**

To further improve our recycling, we recommend that methods of waste reduction and reuse be utilised as much as possible in the laboratory to reduce the amount of waste incinerated. Note that waste placed in the non-hazardous (black) bins located in the labs is also sorted by SUEZ and then recycled or incinerated as described above.

Waste hierarchy





Batteries

There is currently a battery recycling station located at the bottom of the staircase on the ground floor of the Mary Kingsley building (formerly known as “the Old Building”). When this recycling station is full, the batteries here are collected by <http://www.batteryback.org/> and recycled at their battery recycling centre in Halifax.



Disposal of large lab equipment

When large lab equipment no longer works, this can be collected by Estates and will be processed by our Waste Collection company Suez for disposal or recycling.

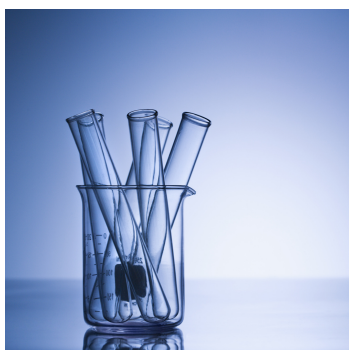


Tips on reducing laboratory waste

Single-use, or disposable, products are often necessary in lab procedures to prevent contamination, maintain sterility, and to speed up processes. However, they are also a huge component of a lab’s waste portfolio. To minimize the harmful environmental impacts of incineration, the mindset of reduce, reuse, recycle should be adopted wherever possible. Highlighted in the next image are some simple techniques which can help reduce your lab waste whilst simultaneously saving your group money.



TOP TIPS TO REDUCE, REUSE, RECYCLE



Move away from single use goods

Invest in durable and reusable goods as much as and wherever possible, rather than single use. Could you in some instances switch to glass bottles over plastic falcon tubes and utilise laboratory dishwashers which are available in both CTID and LLSA – **See procurement section for more ideas**



Share equipment and supplies

We recommend keeping an up-to-date equipment and chemical inventory that can be shared with other groups. EWG are in discussions with the Technicians Make It Happen committee to coordinate lines of readily accessed and responsive communication.



Reuse non-contaminated materials

Such as using empty pipette boxes to hold items on your desk or even at home (they stack very nicely for screws/nails, craft supplies, spices or toys), rather than throwing them out



Unsubscribe

From unwanted paper versions of journals, catalogues, or magazines, or re-subscribe for electronic versions





Design experiments to be as efficient as possible

To reduce the use of excess waste (both chemical and material)



Familiarize yourself with the recycling system in LSTM & Liverpool

To insure items are placed in the proper bins by you and your group and thereby disposed of properly



Purchase from companies that provide supplies in recyclable containers

See procurement section for more ideas



ENERGY AND EQUIPMENT

Energy reduction strategies are a vital component of greening your lab space. Labs account for a significant portion of the LSTM campus (CTID and LLSA) and typically have large items of equipment running continuously.

By turning things off, replacing older equipment with newer high-efficiency models, and swapping incandescent bulbs for LED fittings, you can have a significant impact on energy use in the lab.



General actions and recommendations

Turn off equipment when not in use. If equipment does not have to be left running use “Turn Off” stickers to provide the correct instruction to all lab members.

- Turn off incubators, ovens, and water baths overnight and on weekends, if possible.
- Turn off infrequently used equipment at the socket. Anything that is left plugged in with the socket turned on, whether it is powered on or off, draws energy from the electrical outlet. Avoid this energy loss by unplugging equipment that is not used regularly.
- Any equipment that generates heat, including drying cabinets, water baths, incubators, ovens fridges and freezers etc. will add heat to the laboratory triggering the air conditioning, and ultimately, requiring additional energy use.
- Determine if timer switches can be used on equipment so it will be on, ready for use but turn off at the end of the day.

Close equipment securely. Keep doors on autoclaves, incubators, refrigerators, and freezers closed to maintain internal temperatures and avoid excess heat loss or gain.

Automate equipment shutdown. Set computers and printers to automatically enter sleep mode when not in use.

Turn off the lights. When you are leaving the lab for more than 5 minutes or opt for PIR controlled lighting which will turn off the lights after a period of inactivity. You can contact facilities to review lighting within the lab.





EQUIPMENT SPECIFIC ENERGY REDUCTION TIPS

Fume hoods and biosafety cabinets

Fume hoods can be either constant air volume (CAV) or Variable Air Volume (VAV). The amount of air extracted from the room in both cases contributes to the large energy usage of laboratories.

Shut the sash - Fume hood and biosafety cabinet sashes should be closed at all times except during active use. This is best for safety of lab occupants and for energy consumption. An open fume hood uses as much energy as 3.5 homes.

Lowering the sash of a VAV fume hood adjusts the fan speed and the amount of air extracted and can save up to 40% of the energy if it was left on.

When not in use turn off CAV fume hoods or biosafety cabinet. A biosafety cabinet left on can use up to 15kWh/day. Learn how to use your fume hood or biosafety cabinet so you can save energy as well as work safely.

Standard freezers

- Keep freezers full for maximum efficiency
- Check inventory of freezer stocks regularly and dispose of anything no longer needed
- Share freezer space with another lab instead of buying another unit when possible (contact techysforum@lstmed.ac.uk for more info)
- Use appropriate racking to maximise space and prevent large temperature changes
- Reduce the frequency of times doors are opened and the length of time they are left open
- Defrost regularly (what is regular?)

Low Temperature Freezers

Ultra-Low Temperature (ULT) Freezers use a significant amount of energy and are responsible for a considerable amount of greenhouse gas emissions. An average ULT freezer can use nearly as much electricity each year as an average home. Standard ULT freezers also use refrigerants with a global warming potential (GWP) that is 12,000 times as potent as carbon dioxide.



Purchase High-efficiency (HE) ULT freezers.

High-efficiency (HE)ULT freezers can consume up to 50% less energy than non-HE models and use natural refrigerants that do not contribute to global warming. By replacing older models (more than 10 years old) with HE ULT freezers, you can significantly reduce the energy cost per year. Many models also have "EcoMode" which consumes an additional 15% less energy.

Raise “-80” freezer temperatures to run at -70°C to reduce energy use by up to 40% and prolong the life of the freezer.

Check to see if your samples can be safely stored at -70°C at freezerchallenge.org

Keep charts of freezer stocks and sample locations to avoid leaving the freezer door open while you search for a sample.

Autoclaves

Autoclaves are critical pieces of lab equipment. They are also large consumers of energy and water. A recent study by UC Riverside found that an autoclave uses an average of 45 gallons of water per cycle and 16,000kWh of energy per year. This is nearly 1.5 times the energy use of an entire house. WashU has approximately 150 autoclave units, each requiring this high amount of energy and water.

- Only autoclave items that absolutely require it.
- Set up a schedule to combine items from multiple users or labs.
- Avoid autoclaving 1 or 2 small things at a time, only run full loads.
- Make sure to turn off equipment when not in use (overnight and on weekends) or set up an automated schedule to power down units during off-peak hours.
- Keep autoclave doors closed at all times, besides during loading and unloading, to avoid heat loss.
- Be sure to select the correct setting for the items you are autoclaving to avoid running a second cycle to correct a mistake.
- Do not operate an autoclave without proper training.

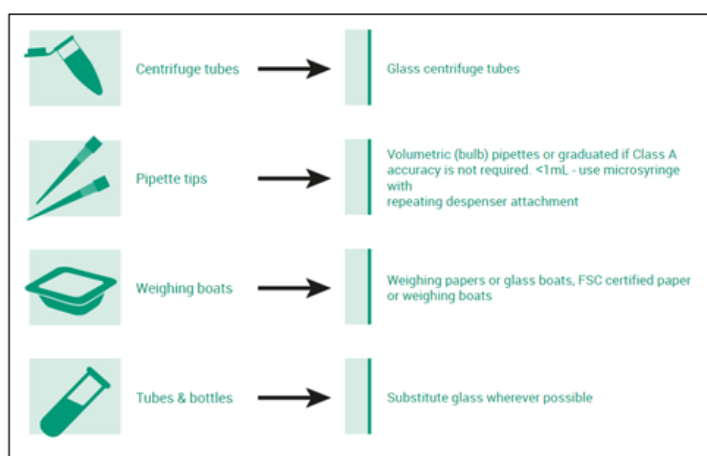


PROCUREMENT

As part of the North West Purchasing Consortia, and in conjunction with other regional consortia, LSTM have significant buying power within the laboratory consumables and chemicals markets. By making a few simple changes to your buying habits, it is possible to significantly reduce the amount of packaging waste that enters your lab and carbon emissions from the shipping process. Many of our recommended suppliers have greener options for commonly used products.

Action items and Recommendations:















- Wherever possible, use the suppliers recommended by the LSTM Procurement team. We are working with these suppliers to develop ways to improve sustainability.
- When purchasing equipment (freezers, fridges etc) opt for ENERGY STAR certified products. Although these might be slightly more expensive to purchase, they will save money one energy costs in the longer term.
- Buy in larger quantities when possible to reduce packaging and avoid multiple shipments. Consider if you can place 2-6 month orders of commonly used supplies such as tips, gloves, falcon tubes etc.
- If you only need one of something, why not ask on the Science Warehouse Users Microsoft Teams group to see if anyone else has one spare
- Return packaging to supplier/reuse Styrofoam packaging
- Sign up to the NWUPC's Sustainability Newsletter to keep up to date on our supplier's sustainable initiatives. - <https://www.nwupc.ac.uk/newsletters>
- Find Greener alternatives for your regularly used items. Consider reusable consumables wherever possible. If you are not sure what is available, speak to the Procurement team or ask the supplier for suggestions.



The Procurement team encourage you to consider the whole life cycle of an item before you make your purchase.

-  Estimated life span of product
-  Origin of product
-  Water consumption
-  Disposal/removal of product
-  Packaging and disposal thereof
-  Recyclability

Green Products

REDUCE		TipOne® Refills: significantly reduce plastic waste with the TipOne® sterile and non-sterile refills.	 Reduces single-use plastic. Space-saving (up to 20% sterile / 35% non-sterile) reduces transport emissions.
		StarGuard® Gloves: Comfort & Sensitive are packed in boxes of 250 & 200 gloves (respectively).	 Up to 40% more gloves in same shipper size reduces transport emissions and packing materials.
		Chemgene Concentrate. Long shelf life.	 Long shelf life reduces waste. Non-corrosive. Biodegradable. No PHMB.
		GuardOne® Workstation: Flat packed for easy transportation. Eco-friendly consumables.	 Minimal packing volume & weight reduces transport needs. Energy-saving LED light. Long-Life UV lamp.
REUSE		TipOne® Racks: reuse your racks with the refill systems over and over again.	 Sturdy reusable racks that have been tested to withstand 100 autoclave cycles.
		Centrifuge Tubes: Racked tubes supplied in eco-friendly recyclable cardboard trays.	 No polystyrene which is very hard/costly to recycle. Cardboard is a sustainable material.
RECYCLE		TipOne®: all components of the system are made from recyclable polypropylene.	 ~1000 tonnes of plastic a year is saved from landfill and sent for recycling by STARLAB customers.



ECO-FRIENDLY SUPPLIERS

Wolf Labs

The Wolf Lab Sustainability pledge can be found at <https://www.wolflabs.co.uk/about/environmental>.

Wolf Labs are a proud supporter of the charity "Cool Earth" that works alongside indigenous villages to halt rainforest destruction.

Wolf Labs can provide kW/hrs for laboratory equipment in situ with a view to monitoring current consumption and then targeting certain equipment types equipment to reduce consumption (e.g. ultralow temperature freezers and warming cabinets).

Qiagen

QIAGEN has committed to reducing carbon emissions in line with a 1.5 degree Celsius climate target. <https://corporate.qiagen.com/about-us/Sustainability/environmental-matters>

Medline Scientific

<https://www.medlinescientific.co.uk/about-us/environmental/>

Medline Scientific WEE Registration Certificate allows them to remove redundant equipment and their internal service engineers endeavour to recycle any parts where possible. They offer initiatives such as Pipette Tip Box recycling and redundant stock at Medline is offered or donated to local schools and colleges to use.

Thermo Fisher

Greener Product Alternatives are marked in the catalogue with a Green Leaf. These products have the following features: less hazardous, less waste; use fewer resources, Energy Efficient, Sustainable packaging, Sustainable disposal.

Thermo Fisher are rolling out a 100% paper, easily recyclable cooler as an alternative to EPS foam. Thermo Fisher pipette tip box recycling program includes a collection bin where you can place all your used boxes and a prepaid shipping label for easy return. They partner with Kimberly Clark's RightCycle recycling program to help you turn your used gloves and garments into all sorts of plastic items including benches, chairs and collection bins.



LSTM GREEN LABS CHECKLIST

Reduce

- If a small quantity is needed check if other users have any spare – Technicians Make it Happen or Science Warehouse Users on Microsoft Teams
- Buy in bulk where possible to reduce shipping costs, packaging and transportation emissions
- Use recommended suppliers
- Design experiments to be as efficient as possible
- Buy 'ENERGY STAR' certified products
- Put 'close the sash' stickers on all hoods
- Put 'shut down stickers' on suitable laboratory equipment and computers
- Energy consumption of fridge and freezers through detailed inventories to minimise the time spent with doors open and storage of unnecessary products – set an annual freezer spring clean
- Unsubscribe from unwanted catalogues and magazines

Reuse

- Switch away from single-use good where appropriate
- Re-use non contaminated waste for alternative uses e.g. Styrofoam or tip boxes
- Return packaging to suppliers where possible

Recycle

- Use the available in-house recycling streams for cardboard, plastic wrapping, glass, and pipette boxes
- Ensure each laboratory has a 'recycling streams for the laboratory' poster in an easy to see location
- Return packing to suppliers where possible



GREEN LABS COMMITMENT

As a member of the LSTM community, I am committed to doing my part when and where I am able, to support environmentally friendly initiatives. I will work with my group to complete the Green Labs checklist. If our group is not able to meet the checklist goals, I will engage with the Green Labs team to work towards an environmentally friendly solution. I will work to support my colleagues in adhering to Green Labs practices and advocate for environmentally friendly actions.

DATE _____

DEPARTMENT _____

GROUP _____

TEAM MEMBERS



