COLD STORAGE UNITS IN LABS
INTRODUCTION

In a typical research university, laboratories consume 40-60% of all energy on campus.[1]

This is no surprise when you consider the wide range of specialised equipment used in these labs, but it does leave room for improvement.

Ultra-low temperature (ULT) freezers are used across Trinity campuses to preserve precious samples. These freezers operate between -40°C and -86°C, and are often essential for the storage of biological or chemical samples. However, the energy cost of each unit is steep, with the average ULT freezer using around 20 kWh each day - the same amount of energy used by a single family home.[2]

ULT freezers are also susceptible to ageing and poor maintenance. Each year of a freezer’s life means a roughly 3% increase in energy consumption, and an extra 8.75kg of CO2 released each month. Buildup of frost on the inside of the freezer also reduces efficiency.[3] Even dust, when it accumulates on the filter and condenser fins, can cause a 25% increase in energy usage.

For example, the New Brunswick U570 units in TBSI, while advertised to use 12.2 kWh, consumes around 19 kWh/day. Likewise the Thermo Scientific Forma 88000 units are advertised to use from 18.5-21.8 kWh/day, but in TBSI are using up to 23.5 kWh/day. This means that the average TCD unit is using well over 35% more energy than it could be!
**01 UP-CHILL YOUR FREEZER**

Involves changing the set temperature of the freezer from -80°C to -70°C. This 10°C difference in temperature is significant to your energy use, but not to your samples. Up-chilling can provide energy savings of up to 20-30%, depending on the freezer unit.[4,5] Storage at -70°C is as safe as -80°C for almost all samples, and the higher temperature can help to prolong the life of the freezer and reduce downtime.[6]

**02 MAINTENANCE**

Can also have a huge impact on energy efficiency for your ULT freezers. Defrosting - clearing out the excess ice on the inside of the freezer - can reduce energy usage by 10%, while removing dust from the filter and condenser fins can save up to 25% - which translates to ~108 kg of carbon dioxide that the atmosphere is spared from.[3]

**03 INVENTORY**

In many cases, samples don’t need to be stored in the freezer at all. ULT units are often populated by unnecessary or forgotten samples which take up space and waste energy.[7] It’s important to keep a sample inventory and regularly perform clear-outs in order to dispose of these unneeded samples. Inventories will also help you find samples or empty slots, reducing the amount of time the freezer is left open. Some samples may not even require cold storage, and would be just as secure at room temperature or in a regular freezer.[8]

**04 MONITORING**

Old or inefficient freezers is important to ensure that they’re not using more energy than they’re worth. Especially for older units, having a clear figure of their energy usage allows you to identify when it’s more efficient to replace a freezer with a newer model.
While the environmental benefit of reducing energy consumption is huge, the direct savings on energy costs for labs are also significant. It’s important to note that over the lifetime of a typical ULT freezer, the energy consumption cost is the largest cost associated with that freezer - even larger than initial purchase cost.[9]

The 30% energy savings associated with up-chilling from -80°C to -70°C degrees corresponded to savings of £300 - £560 (€360 - €670) per unit per year in the University of Edinburgh. This is only taking plug load into consideration - there are further savings for the lab in the form of air conditioning bills. [5]

In the Irish context, electricity is 14.5% more expensive than in the rest of the EU. This means that the savings associated with reducing energy consumption are even more significant in Ireland. [10]

“TO BE HONEST, SCIENTISTS ARE WASTING A LOT OF MONEY. THE MONEY SPENT ON CREATING, USING AND OPERATING LABS INEFFICIENTLY, INCLUDING COLD STORAGE, IS NOT SUSTAINABLE. THE MORE WE CAN DO TO REDUCE OVERHEAD COSTS FOR LABS, THE MORE RESOURCES CAN BE REDIRECTED TO RESEARCH.”

PHIL WIRDZEK, FOUNDER OF THE INTERNATIONAL INSTITUTE FOR SUSTAINABLE LABORATORIES
A recent experiment by Keith Alden, Operations Manager of the TBSI, highlighted the potential benefits of up-chilling for Trinity labs.

25.87%: The average energy savings of up-chilling freezers by 10°C.

24,244kg: The carbon emissions that could be saved through up-chilling in the TBSI.

€17,310: The estimated savings per year from up-chilling across 47 freezers.

There is significant potential for labs across TCD to reduce their carbon footprint and save money without risking sample integrity.

We're aiming to reduce the emissions caused by ULT freezers across campus. To get involved, email us at tcdgreenlabs@gmail.com.
1. https://www.nature.com/articles/d42473-018-00223-9
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<tr>
<th>Task</th>
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<tbody>
<tr>
<td>Check door seals are intact</td>
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<tr>
<td>Clean condenser coils (if you have these)</td>
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<tr>
<td>Clean filters and replace broken ones</td>
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<tr>
<td>Defrost and remove ice from freezers</td>
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<tr>
<td>Create/update inventory for stored samples</td>
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<td>Discard old samples</td>
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