-70˚C is the new -80˚C
Optimising Virology Ultra-low temperature storage

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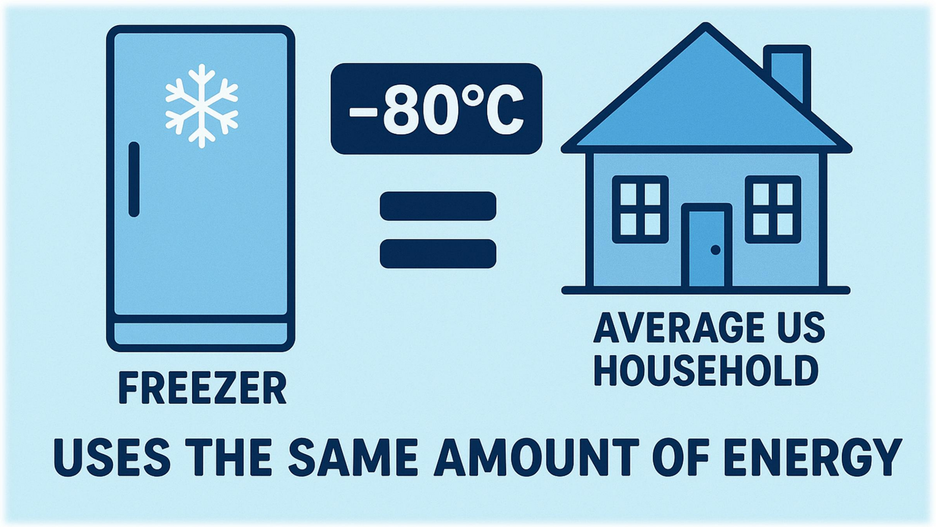
INTRODUCTION

Clinical laboratories use Ultra-Low Temperature (ULT) storage to preserve temperature-sensitive biological samples and reagents, ensuring their long-term viability and integrity for research, clinical studies, and other applications.

ULT storage is incredibly energy intensive. ULT freezers set at -80˚C have been demonstrated to consume as much energy as an average US household (1). Numerous publications suggest that increasing the set temperature of ULT freezers from -80℃ to -70℃ significantly reduces energy consumption and increases freezer lifespan, whilst still safeguarding the long-term integrity of clinical samples and other materials (2,3).



METHODS

We evaluated the impact of transitioning ULT storage from -80℃ to -70℃ within the Department of Virology at Manchester Medical Microbiology Partnership (MMMP). The electrical consumption of various models of ULT freezer were measured at 70℃ vs -80℃ for 7-days using a simple plug-in power meter. 7-day measurements (kWh) were extrapolated to estimate annual electrical consumption and efficiency savings. Annual cost savings were calculated by applying the “saved” electricity (kWh) to the local electricity tariff. The environmental impacts were assessed via calculation of the reduction in Carbon dioxide equivalent (CO_2e) emissions, a composite measure of global warming potential, using the UK Government GHG Reporting Conversion Factors (4).

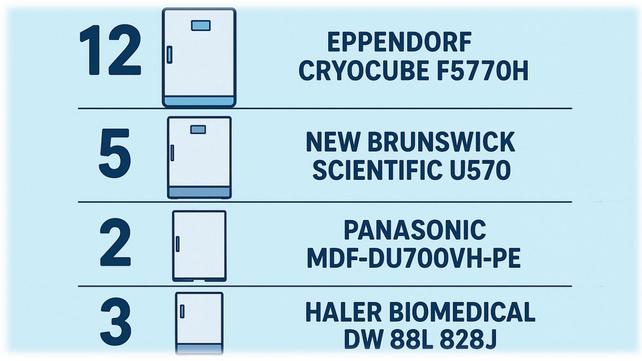


Figure 1: Freezer models currently in-use across the Virology Department

Simple plug-in power meter. These devices are easy to operate and can be purchased from popular online marketplaces.

RESULTS

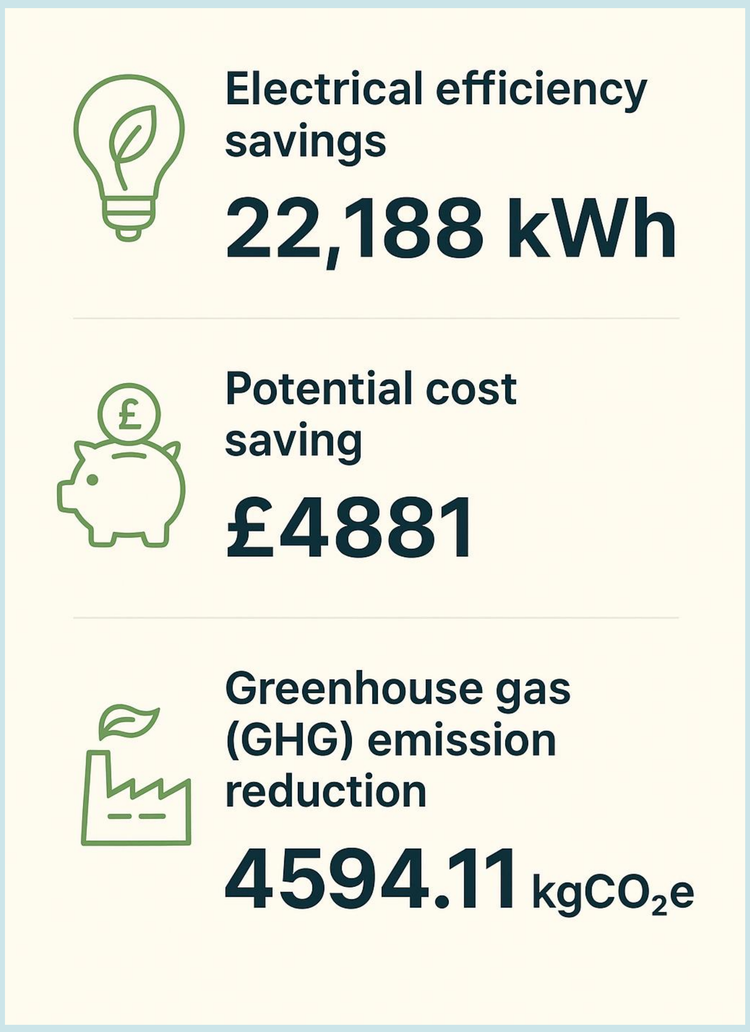


Figure 2. Headline findings: Estimated annual efficiency savings, potential annual cost savings & projected annual CO_2e reduction.

Switching all 22 ULT freezers within the department of Virology from -80℃ to -70℃ resulted in an estimated annual electrical efficiency saving of 22,188.40 kWh. Efficiency savings varied depending on freezer model (Range: 19.43-43.91%, Mean = 22.91%), with Haier freezers showing the greatest reduction in power consumption when switched to -70℃.

Regarding the potential cost savings, applying the estimated electrical savings described above to the departmental electrical tariff, the potential annual cost saving of this intervention is £4881.

Looking at the potential environmental benefits, this study showed a projected annual CO_2e saving of 4594.11kg CO_2e. This is equivalent to driving a standard, small petrol car 19,865 road miles.

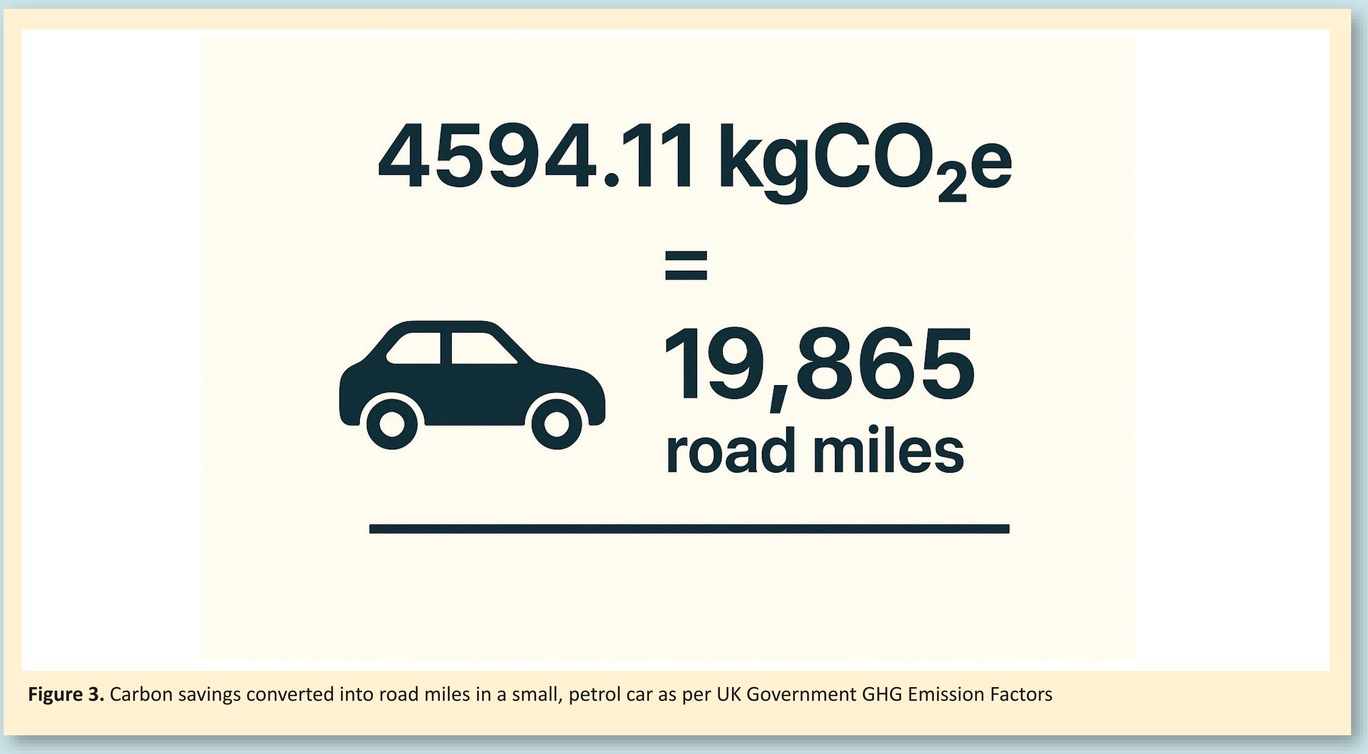


Figure 3. Carbon savings converted into road miles in a small, petrol car as per UK Government GHG Emission Factors

DISCUSSION

Climate change is increasing the frequency and severity of many extreme weather and weather-related events. Increasing average global temperatures are affecting food and water security, worsening air quality and damaging socioeconomic systems. The overarching goal of healthcare is to promote and preserve health, focusing on improving well-being, increasing healthy life expectancy, and achieving equitable health outcomes for all populations. However, paradoxically healthcare is a significant contributor to environmental damages that negatively impact human health. Globally, the carbon footprint of healthcare has been estimated to account for 4.4% of total carbon dioxide equivalent (CO2e) emissions.

Microbiology/Virology laboratories are highly energy intensive. Facilities utilise specialist diagnostic equipment, incubators, safety cabinets, autoclaves and ultra-cold storage. Additionally, heating, ventilation and air conditioning (HVAC) systems employed to sufficiently control humidity and temperature are associated with significant energy consumption (5).

It is evident that clinical laboratories still have work to do to ensure the sustainability of their services. This project, and other published reports clearly demonstrate that optimisation of ULT storage is a relatively innocuous, simple, but impactful change that is translatable throughout laboratory medicine.

CONCLUSIONS

Optimisation of ULT storage is an effective way of reducing electrical consumption and the carbon footprint of the Virology laboratory. Our data demonstrates that significant annual reductions in electrical usage and greenhouse gas emissions is possible with just a simple change in practice.

Clinical laboratories are likely to come under increasing spotlight as the NHS attempts to meet the commitment of ‘Net-Zero’ for emissions directly under NHS control by 2040 and those for which it can influence by 2045. It seems inevitable that “environmental sustainability” will transition from a passion project of a small group of like-minded, eco-friendly lab staff, to an auditable requirement for all laboratory services.

ACKNOWLEDGEMENTS

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