Carbon target and What If scenarios – Supplementary report

The aim of this report is to provide additional information on the University's carbon emissions and the What If scenarios published as part of the new carbon target campaign.

We first explain some terms and definitions and then provide more detail about the calculations and assumptions behind the What If scenarios.

Contents

How are carbon emissions calculated?

The carbon emissions for the University are based on energy consumption. The two main energy uses are **natural gas** (used for heating and ventilating the building and also for producing hot water) and **electricity** (to power all our electronic devices, such as computers, freezers or lab equipment). Burning gas or producing electricity generates carbon emissions, hence carbon footprints are calculated based on energy use.

To calculate carbon emissions, a so-called emission factor is multiplied with the respective energy use to reflect how much CO_2 equivalent (= CO_2e) is emitted for each unit of energy consumed. Emission factors vary depending on the type of energy used and are updated every year based on the UK's fuel mix. They are published annually by the Department for Business, Energy & Industrial Strategy (BEIS) and the Department for Environmental Food & Rural Affairs (DEFRA)[1].

Table 1: Energy use and carbon emissions

Fuel type	Energy use (kWh)	Conversion factor (kg CO2e/kWh)	Carbon emissions (t CO2e)
Grid electricity	126,434,297	0.28307	35,790
Natural gas	99,958,997	0.18396	18,388

The total energy use and carbon emissions are reported for the Estates Management Record (EMR), alongside other metrics on estate size and performance. Data is collected by HESA and is available online[2].

The University also uses some other energy sources with different conversion factors and generates some electricity on-site e.g. through solar photovoltaic and combined heat and power (CHP) plants. Unlike burning fuel for heating and electricity, solar PV doesn't generate emissions. Accordingly, the cleaner the energy generation is, the lower are the conversion factors which are applied for this type of energy. Therefore, the total carbon emission for the last reporting period 2017/18 were **54,585 tonnes of CO_2e.**

What does 'peak emissions' mean?

The University's carbon emissions are reported on an annual basis. The reporting year is the same as the University's financial year from 1 August to 31 July of the next year. We have reported energy data and carbon emissions since 2007/08. The energy consumption for each year is displayed in Figure 1.

In 2009/10 carbon emissions were even higher than in 2007/08, but they have fallen ever since. Therefore, the level of carbon emissions in year 2009/10 are defined as 'peak emissions'.

[1] https://www.gov.uk/government/collections/government-conversion-factors-for-company-reporting
[2] https://www.hesa.ac.uk/collection/c17042

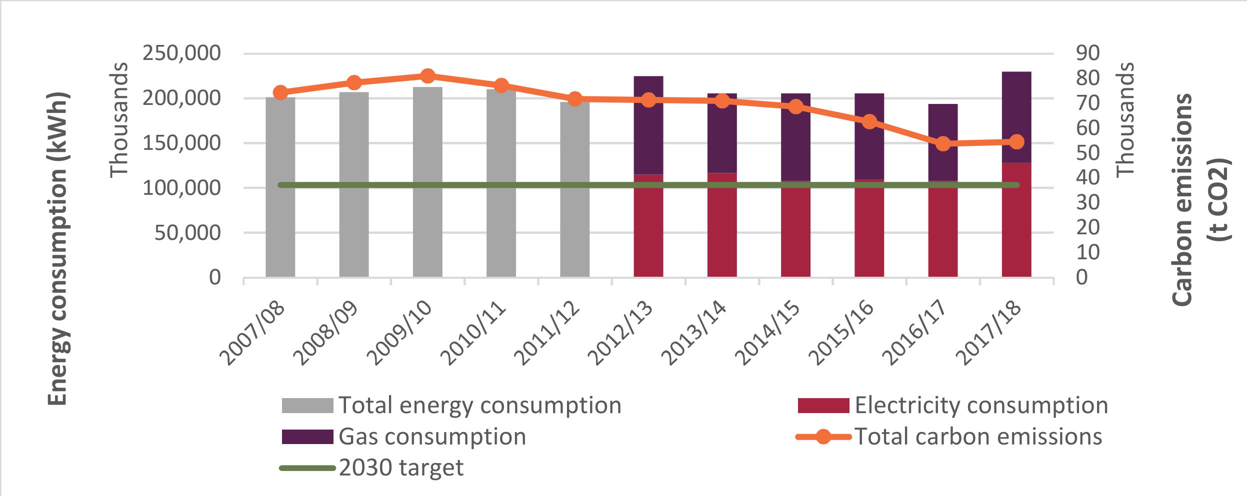

Figure 1: Energy consumption & carbon emissions

The increase for 2017/18 can be explained with the fact that the area of the estate for which energy consumption information has been reported grew by 25%. This significant change is due to improvements in data availability for space embedded within the John Radcliffe hospital sites. This is reflected in the increase in consumption metrics and affects the decarbonisation trend. Moreover, the estate as a whole has grown by 3.2%.

What does 'carbon intensity' mean?

The total amount of energy used and therefore the University's total carbon emissions depends on the size of the estate. The more buildings we operate, the more energy is required to keep them going. The gross internal area is of the University's estate is shown in Figure 2. Today's floor area is more than a third greater than in 2006, so we've been trying to cut emissions while operating more and more buildings.

If we look at emissions per m^2 it becomes clear that we haven't done too badly: emissions per m^2 dropped, from 143kg in 2009/10 to 87 kg in 2018/19, which is a reduction of almost 40%.

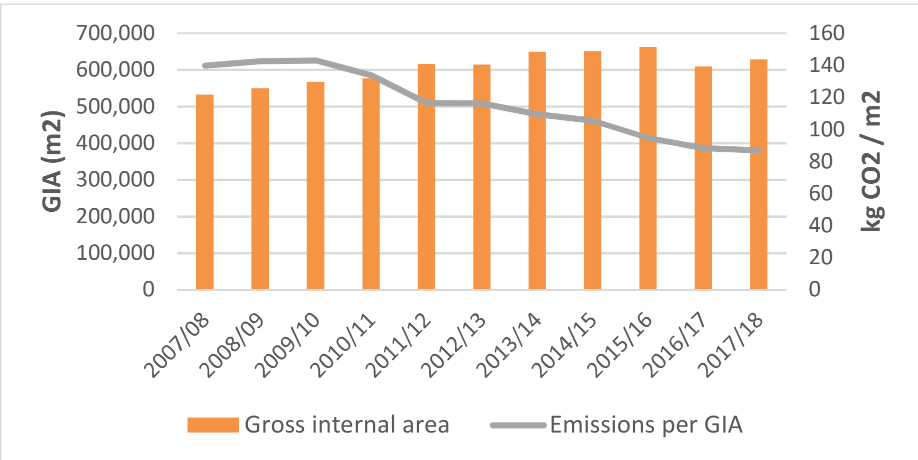

Figure 2: Estate size and carbon emissions per m^2


WHAT IF...
ENVIRONMENTAL SUSTAINABILITY at OXFORD
UNIVERSITY OF OXFORD
YOUR DEPARTMENT USED SPACE MORE EFFICIENTLY?

What if... your department used space 10% more efficiently?

Background

The University's estate includes more than 300 buildings, with a gross internal area of 628,320 m^2. We are making a hypothesis here and assume that by using space 10% more efficiently, we should be able to reduce energy use by 10% accordingly. In reality there are of course many other factors that have to be taken into account, in particular what the space is used for. For example, laboratories and data centres tend to be more energy hungry, and thus carbon intensive then offices or teaching spaces. However, assuming an average of 10% energy saving potential provides a good starting point.

Calculations

If energy use is reduced by 10%, this also means that carbon emissions are 10% lower, which equals **5,458 tonnes of CO_2e**. Moreover, we can calculate potential savings on energy bills by looking at the total energy use and current price levels: Saving 10% on energy will therefore lead to savings of **£1,943,523**.

Table 2: Energy use and cost

Fuel type	Energy use (kWh)	Price (£/kWh)	Cost (£)
Electricity	126,434,297	0.13	16,436,459
Gas	99,958,997	0.03	2,998,770
Total			19,435,228

We have also looked at which buildings have the highest energy use per m^2 and accordingly the highest carbon intensity (=emissions/m^2). Together these have a gross internal area (GIA) of 63,369m^2, which is just over **10%** of the University's functional estate. However, their CO_2 emissions add up to **almost 30%** of the University's total carbon footprint. Most of the buildings with high carbon footprint are labs, because they need a lot of energy for ventilation and specialist equipment.

Find out more

The energy intensity of different buildings varies a lot. More details about the carbon footprint and carbon intensity of each building can be found in our emission map online[3].

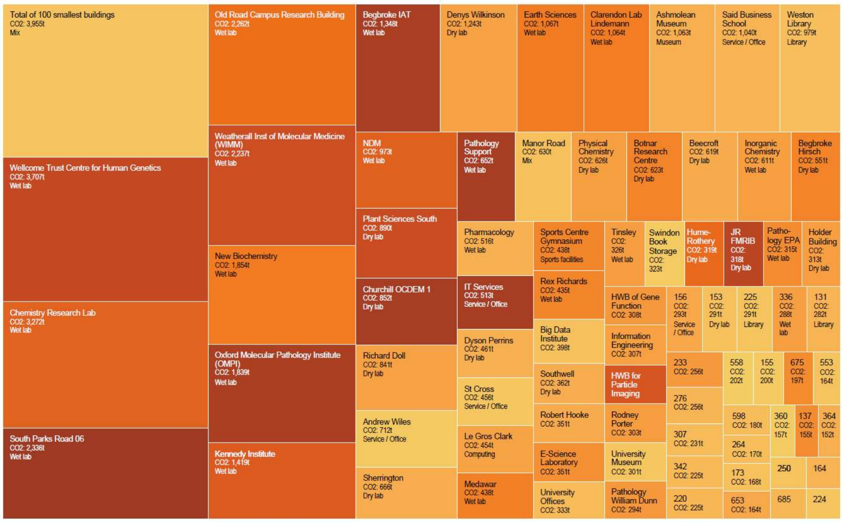

Figure 3: Emission map

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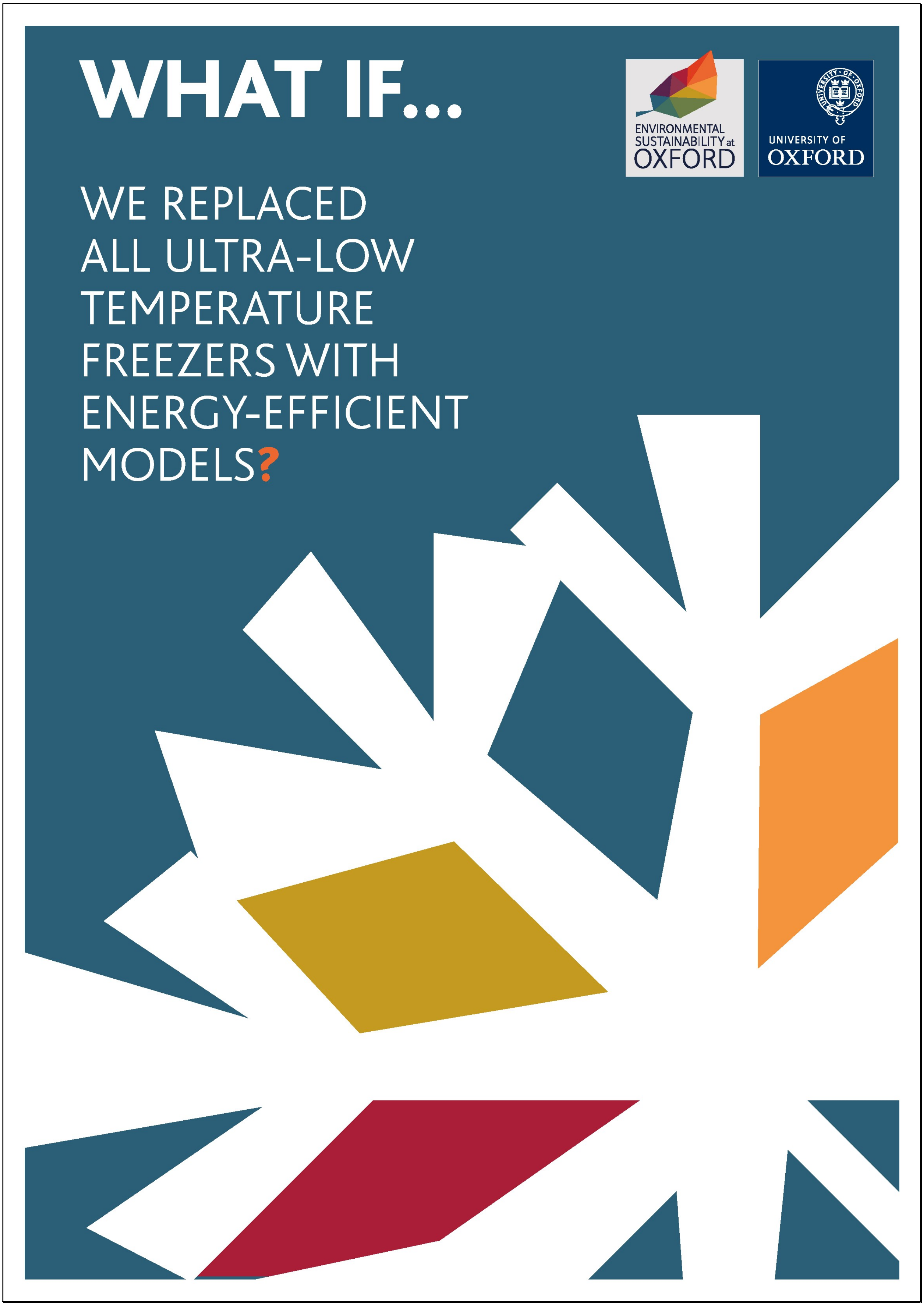
[3] https://sustainability.admin.ox.ac.uk/carbon-and-energy#collapse933876


WHAT IF...
WE REPLACED ALL ULTRA-LOW TEMPERATURE FREEZERS WITH ENERGY-EFFICIENT MODELS?
ENVIRONMENTAL SUSTAINABILITY at OXFORD
UNIVERSITY OF OXFORD

What if… we replaced all ULT freezers with energy-efficient models?

Background

Ultra-low temperature (ULT) freezers are used to store samples at -80°C. We have over 600 of them across the University, many of which are over 20 years old. Their technology has improved massively and models available today are over 75% more energy efficient than 20 years ago.

Figure 4: Energy use of ULT freezers

The Environmental Sustainability team has managed a project funded by the University's Carbon Management Fund to replace the most inefficient units. 11 departments have so far received brand-new super-efficient freezers saving up to 115 MWh of electricity and 35 tonnes of CO_2e per year and meaning the replacement programme will have paid for itself after less than nine years. We wondered how much better we could do if we replaced **all** ULT freezers with the most energy efficient version…

Calculations

The ULT freezer project started with a comprehensive audit, to assess the quantity and conditions of the ULT freezer across the University. The audit showed that there is a wide variety in terms of size, age, and condition. Freezers range from small 100l units to large ones with around 1,000l of sample storage space.

A useful measure is to look at the electricity consumption by storage volume. The average size of our current freezer stock is 606l and the average consumption is 28.43 Watts per litre per day. In contrast, the electricity consumption of the new efficient freezers is only 13.77 Watts per litre per day on average – over 50% less than our current consumption. Therefore, if we had enough money to upgrade our freezer stock to only the most efficient units, we could save about 1,894,470 kWh/year on electricity, which means savings of **537 tonnes CO_2e** per year and **£246,411**. In addition, we could expect further savings due to reduced air conditioning demand in the freezer rooms.

Table 3: Freezer energy use

Description	Measure	Unit
Number of freezers	584	
Total volume of freezers	354,113	l
Average consumption	28.43	W/l/day
New consumption	13.77	W/l/day
Electricity savings	1,895,470	kWh/year
Electricity savings	246,411	£/year
Annual CO_2 savings	537	t CO_2e / year

Find out more

Further information on energy saving opportunities and sustainability in laboratories can be found on our sustainable labs website section[4]. This includes resources available, information about the Carbon Management Fund, details about the sustainable freezer scheme and lots more!

[4] https://sustainability.web.ox.ac.uk/sustainable-labs


WHAT IF...
YOUR COLLEGE MATCHED OUR NEW TARGET FOR 2030?
ENVIRONMENTAL SUSTAINABILITY at OXFORD
UNIVERSITY OF OXFORD

What if… your college matched our new target for 2030?

Background

Climate change is a pressing global issue and everyone in the University has a role to play. However, our new target doesn't extend to the colleges because they are self-governed and decides independently whether they should have a carbon. Given that the colleges collectively use almost as much energy (about 82%) as the rest of the University, the savings they could make by adopting the University's carbon target are huge.

Calculations

The University buys electricity and gas for the colleges, and based on this data, we can calculate the total carbon emissions of the colleges.

Table 4: Accumulated college energy use

Fuel type	Energy use (kWh)	Carbon emissions (t CO2e)	Reporting period
Grid electricity	54,697,130	15,483	2017-18
Natural gas	131,433,079	24,178	2016-17
Total		39,662	

Since the University's reference year of 'peak emissions' doesn't apply to the colleges, it makes more sense to look at their most recent emissions and how adopting the University's carbon target could apply to them.

As a first step we can work out what level of reduction is required based on our current emission levels to reach the target. This would be a level of 25.8%. If colleges were able to reduce their current emissions by 25.8%, this would accordingly lead to savings of 10,233 tonnes of CO_2. These savings wouldn't help to achieve the University's carbon target but at current price levels, colleges could realise annual energy savings of around £2.85 million. These direct savings could be allocated to further improve teaching, housing and wellbeing making colleges a more sustainable place to live, work and study.

Find out more

If you want to find out more about what you can do to save energy and make your college more sustainable, visit Oxford's Student Union at https://www.oxfordsu.org/

Visit our website at

https://sustainability.admin.ox.ac.uk

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