Utilities Consumption, Costs and Carbon Management 2008 – 2022 Progress Report

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	Date	Status	Key Changes
v1	06-Feb-23	First complete Draft Issued for comments	
v2	01-Apr-23	Final Issue	Added Fuel Vehicles Fleet Consumption and related Carbon Data. Worked out Scope 1 and 2 carbon emissions only, graphs and progress against. Executive Summary format/content and Data Summary fully re-worked. Savings completed projects worked out value at current prices and current carbon factor, and improved presentation. Removed previous section "Potential for space heating carbon emissions reductions". Added "How far are we from reaching Net Zero by 2050" and worked out comprehensive content. Graphical improvements. General review.

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EXECUTIVE SUMMARY

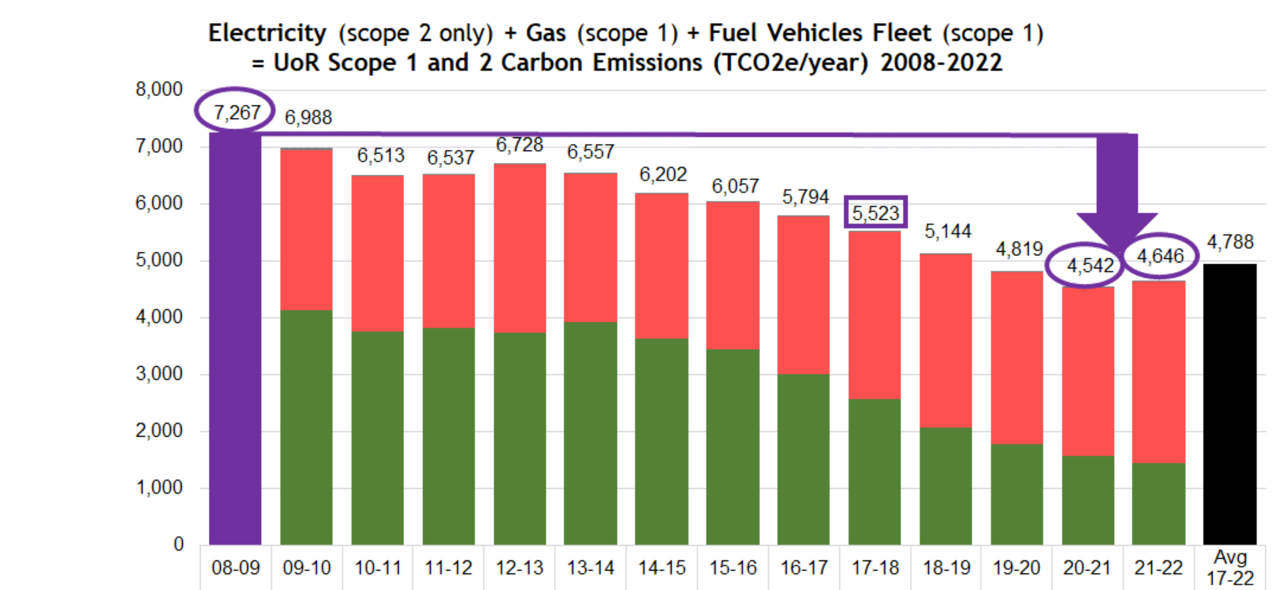
You're busy, we know. You don't have time, or need to, delve into nearly 50 pages of graphs? This 11 pages Executive and Data Summary is, for you. It is packed with facts and key learnings from this comprehensive analysis.

Need further insight on how we came to these conclusions, or, utilities usage/cost/carbon data ratios for reference with other work? Please use the Table of Contents and Table of Figures to take you where you need to in the body of the report.

The **purpose of this report** is to disseminate data and analysis relative to the University of Roehampton utilities consumption and carbon emissions impact in the 14 years period 2008 to 2022. By publishing our journey and current position we aim this report to assist with the writing of the company's Net Zero Carbon Strategy to 2050.

HAVE WE ACHIEVED OUR AMBITIOUS -40% BY 2020 'SCOPE 1 AND 2' CARBON REDUCTION TARGET VS FY08-09 SET IN OUR 2011 CARBON MANAGEMENT PLAN?

Yes nearly! Scope 1 and 2[1] carbon emissions have reduced by -38% in <u>absolute terms</u> from 7,267 in 2008-09 baseline year to 4,542 TCO2e/year in 2020-21 i.e. **<u>despite</u> a 31% increase in the Estates size[2]** which has added **+24%** on utilities usage, costs and carbon emissions, **we have nearly reached our ambitious -40% by 2020 scope 1 and 2 carbon reduction target set in our 2011 Carbon Management Plan!**



	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Avg 17-22
■ TCO2e / year	24	27	24	24	24	23	26	23	18	18	18	16	7	13	13
■ TCO2e / year	2,736	2,827	2,722	2,687	2,975	2,617	2,551	2,588	2,764	2,946	3,062	3,030	2,970	3,198	3,041
■ TCO2e / year	4,507	4,134	3,767	3,827	3,729	3,917	3,625	3,446	3,011	2,559	2,064	1,774	1,564	1,436	1,879
vs 08-09 Baseline		-4%	-10%	-10%	-7%	-10%	-15%	-17%	-20%	-24%	-29%	-34%	-38%	-36%	-34%
vs 17-18 Baseline											-7%	-13%	-18%	-16%	-13%

[1] The World Resource Institute developed a classification of emission sources around three 'scopes': 'scope 1' are direct emissions that occur from sources owned or controlled by the organisation (e.g. gas for space heating/hot water/catering and fuel for its vehicle fleet) ; 'scope 2' accounts for emissions from the generation of purchased electricity consumed by the organisation; 'scope 3' covers all other indirect emissions which are a consequence of the activities of the organisation, but occur from sources not owned or controlled by the organisation (e.g staff and students commuting, air and land-based business travel, water supply and wastewater treatment, transportation and distribution of electricity, waste and procurement). This approach has been widely adopted. At UoR Scope 1 emissions correspond to emissions resulting from our use of natural gas and diesel+petrol vehicles fleet. Scope 2 emissions correspond to emissions resulting from the generation of purchased grid-electricity.

[2] Construction of Chadwick (Sept 2015) and Elm Grove (Sept 2016) students residences, and a new Library (Sept 2017).

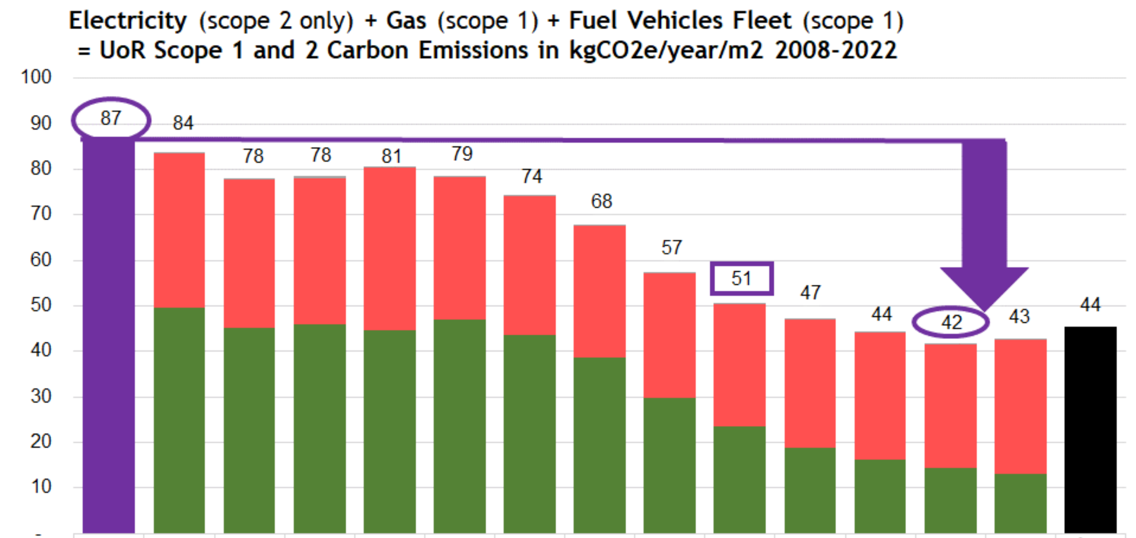
However, in <u>relative terms</u>, scope 1 and 2 carbon emissions are 52% lower (at 42 kgCO2e/year/m2) **than in our 2008-09 baseline year** (at 87 kgCO2e/year/m2)**. In relative terms our -40% 2020 target has been overachieved!**

So, in absolute terms (what's really needed for climate change mitigation) we have nearly reached this target (38%) but in relative terms per m2 (which takes into account the fact the Estates has increased in size since the baseline year 08-09) we have overachieved it (52%).

This is mainly **thanks to our continuous efforts to save electricity, helped by the decarbonisation of the UK Grid Electricity.**

Whilst there is a <u>lot more to do</u> and at a <u>much higher speed</u> to reach 'Net Zero Carbon' and attempt to keep climate changes under control, this is a **very significant achievement for University of Roehampton whom employ <u>only 1 'environmental sustainability' member of staff</u> to reduce the usage of and manage a vast range of utilities activities:** energy/carbon strategy, energy/water projects identification/survey/development/management, utilities monitoring, utilities purchasing, utilities budgeting/forecasting, metering maintenance, energy/carbon compliance, utilities usage/costs/carbon data reporting, energy projects funding, advising, utilities suppliers communication, networking, creating or keeping up-to-date essential assets lists/maps, etc.

<u>ARE WE 'ON TRACK' TO ACHIEVE OUR -25% BY 2025 'SCOPE 1 AND 2 PER M2' CARBON REDUCTION TARGET VS FY2017-18 SET IN OUR 2019 ENABLING STRATEGY?</u>



	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Avg 17-22
kgCO2e / year / m2 (grey)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.1
kgCO2e / year / m2 (red)	33	34	33	32	36	31	31	29	27	27	28	28	27	29	28
kgCO2e / year / m2 (green)	54	50	45	46	45	47	43	39	30	23	19	16	14	13	17
vs 08-09 Baseline		-4%	-10%	-10%	-7%	-10%	-15%	-22%	-34%	-42%	-46%	-49%	-52%	-51%	-50%
vs 17-18 Baseline											-7%	-13%	-18%	-16%	-13%

Yes, nearly on track. Scope 1 and 2 carbon emissions per square meter are 18% lower (at 42 kgCO2e/year/m2) **than in the 2017-18 baseline year** (at 51 kgCO2e/year/m2).

We are nearly 'on track' to achieve our -25% by 2025 'scope 1 and 2 per m2' carbon reduction target set vs FY17-18 in our 2019 Enabling Strategies. There is less than 3 years to achieve a further -9% reduction at organisation level.

THE VALUE OF PROACTIVE ENERGY MANAGEMENT AND COMPLETED UTILITIES SAVINGS PROJECTS 2010 – 2022

	Costs			Savings				
	Total Invested	Salix funding	UoR funding	Energy (MWh)	Financial as at project closure	Financial as at FY23-24 expected utilities prices	TCO_2 as at project closure	TCO_2 as at 2022 carbon factors
61 projects	£3.4M	£2.7M	£0.7M	5,001	£710k	£1,294k	1,927	1,018
		80%	20%					
Equiv. to the average annual energy consumption of				313	households in the UK			

In the **last 13 years** the University has **invested £3.4million** in **61 projects** with 5 to 10 years payback to reduce utilities usage, associated costs and carbon emissions. 80% was funded from Salix interest-free loans and revolving funds, successfully applied for and managed in-house[3].

Annual energy savings are totalling 5000 MWh/year which is **equivalent of powering and heating 313 UK homes for a year.**

Energy Management is saving the University of Roehampton £530,000 in utilities every year (as calculated with utilities prices at the time of project closure) **which is valued today at £1.3M p.a.** with the current energy prices crisis. We currently expect to pay nearly **£4M** for our **energy in FY23-24**. This means, **should we have not 'invested to save' we would be faced with a £5.3M energy expenditure.**

In addition, one-off refunds/savings totalling £180,000 were realised by analysing and challenging erroneous/overcharges in utilities bills.

In total, thanks to our 'invest to save' projects and proactive utilities management, the equivalent of **1018 tonnes of CO2 p.a.** (as at current 2022 carbon factors) is **not released into the atmosphere** which alone **reduce our current carbon footprint by -18%.** This means, **should we have not 'invested to save' our Utilities Carbon Emissions, currently at 4725 TCO2e/year would be 5743 TCO2e/year.**

Type of key projects:

- ✓ Over 14,000 lighting replacements to LED with motion and daylight controls
- ✓ 508m2 of Solar Electricity panels installed
- ✓ 1750 Thermostatic Radiator Valves installed
- ✓ Voltage Optimisation of our 7 main electricity supplies
- ✓ 4000m2 of 30cm thick loft insulation in all buildings with unoccupied pitched roofs
- ✓ 1875m of heating pipework insulated
- ✓ Draught proofing of 615 windows and doors
- ✓ Detection and repair of gas and water leaks

Of all projects, the predominant type was **lighting** with **73% of the total invested** (23 projects) replacing **in total over 14,000 luminaires** to **quality, long lasting and energy-efficient LED** luminaires **with motion and daylight sensors**. Each project typically reduces electricity used for lighting by **80%**, with **invaluable maintenance benefits** with much reduced re-lamping.

These substantial results were achieved with only 1 Energy Manager and some Project Management support.

[3] The Energy Manager is the Salix Fund Manager and deal with all internal and external communications and reporting requirements to Salix Finance Ltd.

LOOKING AHEAD: WHERE TO FOCUS OUR EFFORTS? WHICH UTILITY IS MORE VALUABLE TO SAVE?

The highest proportion of our scope 1 and 2 carbon emissions is for Gas at 69%, followed by Electricity at 31% and Fuel Vehicles Fleet at only 0.3%. However not the easiest, quickest and cheapest type of projects to realise, this mean, **from a carbon emissions reduction perspective, our focus should be on reducing gas usage.**

Electricity represents only 1/3 of our energy consumption but 2/3 of our energy costs. Indeed electricity is typically 4 times more expensive than gas. This is in turn makes **electricity savings projects financially more valuable**.

HIGH-LEVEL GAP ANALYSIS CALCULATION OF THE POTENTIAL FOR FURTHER UTILITIES CARBON EMISSIONS REDUCTIONS TO REACH NET ZERO CARBON BY 2050

In June 2019 the UK became the first major economy in the world to pass net zero emissions law to end its contribution to global warming by 2050. In April 2021 it announced it would enshrine a new target in law to slash emissions by 78% by 2035 to bring the country more than three-quarters of the way to net zero by 2050.

Net Zero refers to the balance between the amount of greenhouse gas (GHG) that's produced and the amount that's removed from the atmosphere. It can be achieved through a combination of emission reduction and emission removal. **'Net Zero'** focus on reducing carbon emissions as much as possible first, and only offsetting[4] unavoidable, residual CO2 as a last resort.

So, how much more could we reduce our scope 1 and 2 carbon emissions? Whilst this is the purpose of our Net Zero Strategy we have attempted to high-level assess the impact of a few significant pathways to a lower carbon future at University of Roehampton.

				Utility affected
1	⇨	Complete LED Lighting + sensors Programme		ELEC
2	⇨	Space rationalisation		Heating mainly usually GAS and ELEC, WATER
3	⇨	Campus-wide BMS Centralisation + Upgrade/Expansion or Local Heating Controls		Heating mainly usually GAS
4	⇨	Buildings Insulation Retrofit Programme to the EnerPHIT standard		Heating usually GAS
5	⇨	Replacement of Space Heating Gas boilers by Electric Heat Pumps		GAS down ELEC up
6	⇨	Further UK Electricity Grid Decarbonisation		ELEC Carbon Content
7	⇨	Own Vehicles Fleet goes Electric (EV)		PETROL DIESEL FUEL down ELEC up
8	⇨	Expand on-site Solar Electricity generation		ELEC

[4] The action of compensating for carbon dioxide emissions arising from human activity, by participating in schemes designed to make equivalent reductions of carbon dioxide in the atmosphere e.g. reforestation or creation of solar/wind/hydro sites across the world. Carbon offsetting is a mechanism used to finance greenhouse gas (GHG) emission reduction/avoidance or sequestration equivalent to the residual emissions of an organisation, business or territory beyond its value chain. This financing is achieved through the purchase of carbon credits.

The above opportunities are probably the ones with the most impact.

There are many other utilities savings opportunities we can consider (non-exhaustive list in the report) that together will no doubts present valuable additional utilities/carbon savings benefits.

It is one of the main purpose of our Net Zero Strategy, yet to be developed, to provide a 'shopping list' of assessed utilities/carbon saving projects to get us as close as possible to these very ambitious goals. It would provide the University with some readiness and a fighting chance to secure rounds of 'green funding' when released e.g. the Public Sector Decarbonisation Scheme (PSDS) provided by BEIS and managed by Salix Finance Ltd.

Commenting on the above pathways: **Electricity reducing measures** are ***somewhat easier* to implement and fund** with likely quicker returns on investments. However, with 69% of our scope 1 and 2 carbon emissions for gas, **from a carbon emissions reduction perspective, our focus should be on reducing gas usage.**

As **about 70% of our gas usage is to heat spaces** (as it typically is) our focus should be on **Heat Decarbonisation Plans/Projects** which government funding has started to target. This would involve technical and financial surveys to **embark at scale on a Buildings Insulation Retrofit Programme to the** EnerPHIT standard (measure 4) coupled with **replacing Space Heating Gas boilers by Electric Heat Pumps** (measure 5). A **working Campus-wide Building Management System (BMS) Centralisation + Upgrade/Expansion** or Local Heating Controls, allowing to adjust remotely and dynamically heating/cooling times/settings to actual needs/buildings occupation (measure 3). And some **Space Rationalisation** by way of more office space sharing and some older building(s) closures.

Heat Decarbonisation measures represent a significant opportunity but a significant challenge.

Heat pumps are 'low-grade heat' (lower supply temperatures than gas boilers) which means to avoid users discomfort/complaints, they **can't be installed in buildings with high heat losses i.e. buildings should be insulated first**. That also mean they don't respond as quickly than gas boilers to changes in heat demands and need to run for longer i.e. are not very suitable/economical for buildings with very intermittent occupation.

Over 1/3 of our buildings stock (about 23 buildings) need a 'whole building approach' energy-retrofit following the motto "*do it right, do it once*". The potential for energy reduction is as huge as the challenge. Financially – simple paybacks are typically 50+ years. Based on £1500 to £2500/m2 of refurbishment costs, we have **guesstimated** that this would probably require **in the range of £60M to £100M investment - how to fund it?** Time-wise/Operationally – 23 buildings to energy retrofit in about 23 years (2050 target) i.e. **1 building/year**, "ideally", for climate change mitigation, sooner/faster i.e. **2 buildings/year** if trying to reach the UK's 2035 target – **how to deliver it? Is that feasible?** This element will very much link with the long-term Estates Strategy.

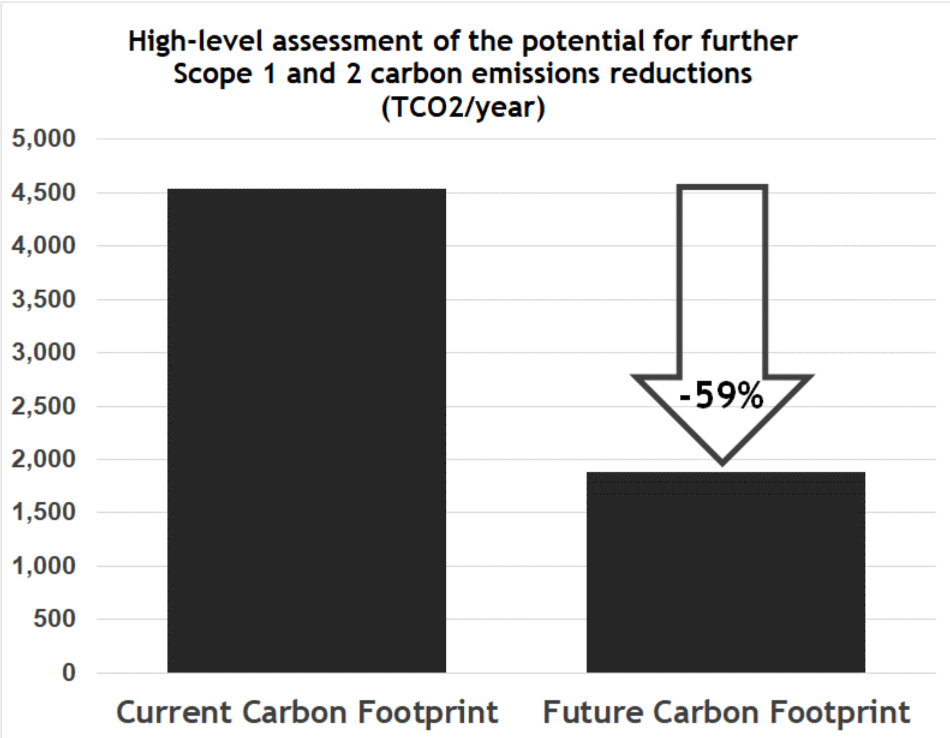
The existing BMS is fairly basic and have suffered 20 years of service life with inexistent to poor management/maintenance, with the exception of in new builds where an essential part of the jigsaw for energy management and maintenance is missing at it is not centralised and accessible remotely at all. It is a fairly **technical/complex, multi-year, inter-departmental Estates-IT project** that would bring valuable energy/maintenance/users satisfaction benefits but **need human project resources and capital investment**.

Space rationalisation finally we feel is **fairly easy in comparison and rather effective** in the case of buildings decant/closure.

Potential negative impacts on utilities consumption and carbon emissions by 2050 (these were not accounted for in our high-level calculations):

⇨ Increase in the size of the Estates.
⇨ Electric Vehicles charging on campus for staff and students.
⇨ More equipment, more students/staff.

It must be noted that, whilst there is some logic and basis for our calculations, without the necessary survey details, the below use a number of assumptions, merit to be further developed and externally verified, and so is indicative at this stage.



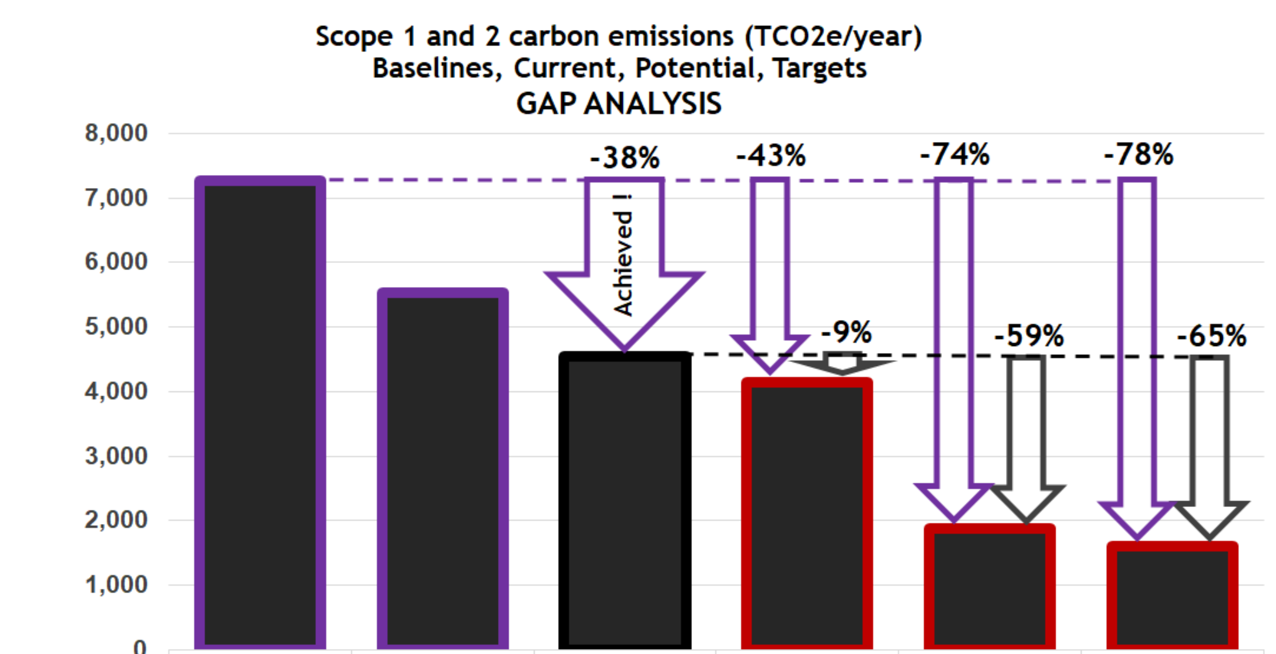
We think the 7 measures listed further above, together with the **UK plans to further decarbonise the production of electricity by half**, could further reduce our scope 1 and 2 carbon footprint by about 60%.

Achieving this (!) would represent a -74% reduction vs our FY08-09 baseline which, with some of the other measures not assessed (high-level) would see us meeting the -78% target set by the UK government, with the remainder 'hard to reach' or 'necessary for our operations' to be offset in order to reach Net-Zero.

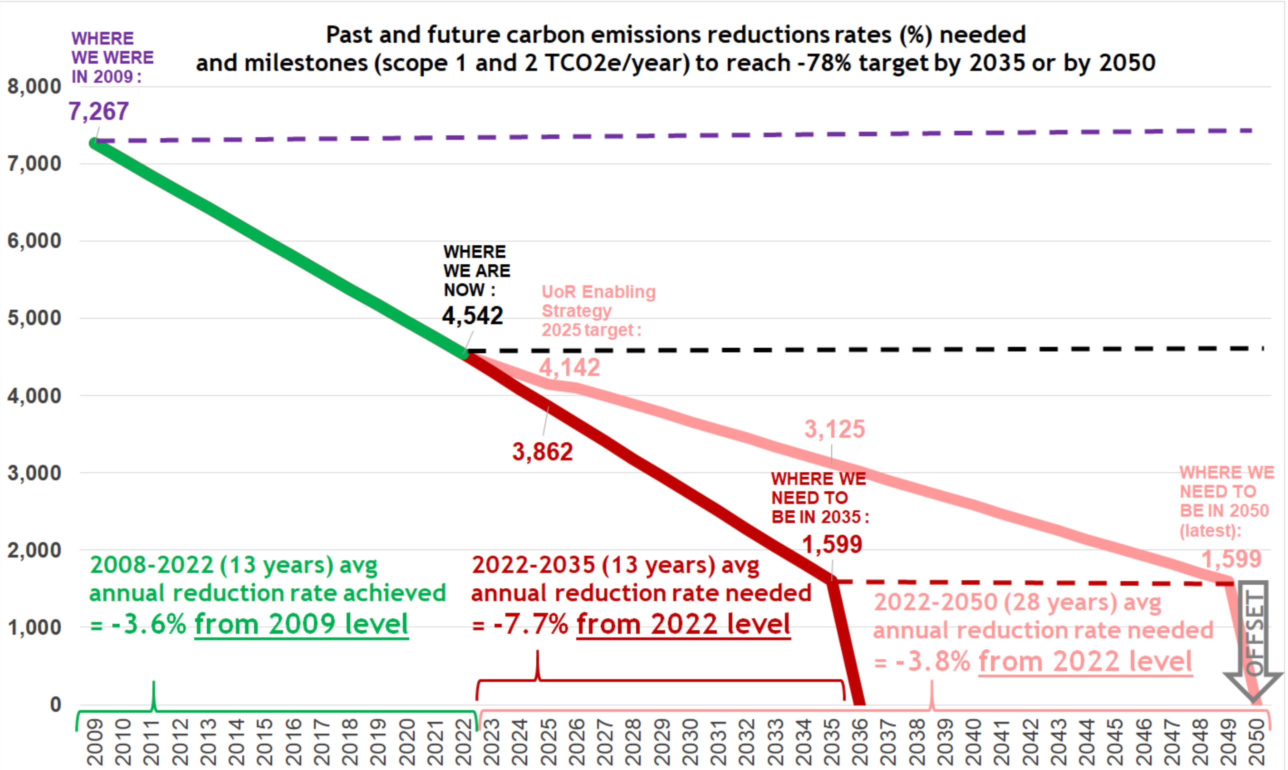
Our scope 1 and 2 carbon footprint:

- **was 7,267** TCO2e/year in 08-09
- **currently is 4,542** TCO2e/year (-38%)
- **need to reach 4,142** TCO2e/year (-43%) **by 2025** to meet UoR Enabling Strategy Target
- **need to,** and in theory can, **reach 1,599** TCO2e/year (-78%) **to meet UK Target / Net Zero**

The UoR Enabling Strategy Target is on the right trajectory to achieve -78% by 2050, however not reaching far enough to achieve -78% by 2035.



	FY08-09 Baseline Carbon Footprint	FY17-18 Baseline Carbon Footprint	Current Carbon Footprint	UoR Enabling Strategy Target* by 2025	8 Pathways High-Level assessment of the potential for further reductions	78% UK Target by 2035
TCO2e/year	7,267	5,523	4,542	4,142	1,878	1,599
vs FY08-09			-38%	-43%	-74%	-78%
vs FY17-18			-18%	-25%		
vs current				-9%	-59%	-65%



The figure above represents the **size of the challenge**:

- Our -38% absolute reduction 2009-2022 (13 years) translate into an **average reduction rate of -3.6% per year, from 2009 levels**.

- To achieve the -78% UK target and Net Zero by 2050 at the latest, we need to further reduce at an **average reduction rate of -3.8% per year, from 2022 levels**.

- To achieve the -78% UK target and Net Zero by 2035 as set in the law, we need to further reduce at an **average reduction rate of -7.7% per year, from 2022 levels**.

Inevitably, with the exhaustion of 'low hanging fruits' ('easier' to implement energy/carbon savings projects), **it will become much harder in time to even 'just' achieve a similar average reduction rate (-3.8%) to what we have already achieved (-3.6%)** and from a lower starting point too (from 2022 level as opposed to from 2009 level).

To effectively mitigate the environmental and financial impact of **climate changes** for all life on earth **we should follow the very challenging average reduction rate of -7.7% per year, from 2022 levels.**

It is the **main purposes of our Net Zero Strategy** yet to be developed, in line with other University Strategies such as the Estates Strategy, to identify different pathways to achieve these ambitious goals, quantify savings, assess at least at high-level technical and financial viability of a wide range of carbon savings projects/options and prioritise them, in discussion with Executives, for action.

A robust Strategy will provide the University with some readiness and a fighting chance to secure 'green funding' when released e.g. the Public Sector Decarbonisation Scheme (PSDS) provided by BEIS and managed by Salix Finance Ltd.

KEY DATA SUMMARY

Absolute variation current usage vs FY08-09 baseline

		08-09		21-22		Current Estates	Existing Estates
Electricity	reduced from	9,127	to	7,426	MWh/year	-19%	-41%
Gas	increased from	14,773	to	* 16,576	MWh/year	* +12%	* -9%
Energy	increased from	23,900	to	* 24,002	MWh/year	* +0.4%	* -21%
Water	increased from	86,679	to	125,704	m3/year	+45%	+5%
Fuel Vehicles Fleet	reduced from	9,233	to	5,617	litres/year	-39%	NA

* reporting here using average gas usage over last 5yrs because 21-22 was unusually high (we think owing to all windows open/extra ventilation during all heating season to mitigate COVID risks).

In absolute terms, i.e. despite the 31% increase in the Estates size, our **electricity usage has reduced by a significant -19%**, testimony of our continued efforts to reduce usage of this utility, however was compensated by **about +12% increase in gas usage**, because of the construction of Chadwick (2015), Elm Grove (2016) and new Library (2017) meaning our **overall energy is nearly the same today than 14 years ago**, which is a rather good achievement.

Excluding utilities usage from the 3 new builds (i.e. same 'Existing' Estates than 2008-09), **overall energy usage have reduced by -21%, with an impressive -41% reduction in electricity usage and about -9% in gas usage**.

Our **diesel and petrol fuel usage for our own vehicles fleet** (post, security and maintenance vans) has **reduced significantly** too by **-39%.**

In absolute terms, **our water usage has increased significantly** (+45%) and the overall increase trend is not only due to the increased Estates size as the **Existing Estates water consumption is +5% higher** too. This may be due to an increase in students/staff numbers or change in behaviour, undetected water leaks/water wastage (toilets cisterns or urinals constantly flushing, taps hard to close), as well as, the increased weekly flushing requirements during low buildings occupation in the 2 years COVID period to comply with Legionella prevention.

Relative variation current usage vs FY08-09 baseline

		08-09		21-22		
Electricity	reduced from	110	to	68	kWh/year/m2	-38%
Gas	reduced from	177	to	160	kWh/year/m2	-9%
Energy	reduced from	287	to	228	kWh/year/m2	-20%
Water	increased from	1,040	to	1,152	litres/year/m2	+11%

Last 5 years FY17-22 Average consumption

Electricity	7,903	MWh/year	72	kWh/year/m2
Gas	16,576	MWh/year	152	kWh/year/m2
Energy	24,479	MWh/year	224	kWh/year/m2
Water	117,435	m3/year	1,076	litres/year/m2
Fuel Vehicles Fleet	5,593	litres/year		

UK Utilities Carbon Factors 2009 - 2022

Electricity	**-60%**	**0.21**	kgCO2e/kWh
Gas	**-1.4%**	**0.18**	kgCO2e/kWh
Water supply + treatment	**-60%**	0.42	kgCO2e/m3
Diesel Fuel	**-1%**	2.56	kgCO2e/litre
		0.24	kgCO2e/kWh
Petrol Fuel	**-4%**	2.16	kgCO2e/litre
		0.23	kgCO2e/kWh

The Electricity and Gas carbon factors are now very close and **the** UK has plans to further decarbonise the generation of Electricity **up to 0.10 kgCO2e/kWh** i.e by half. The Electricity carbon factors is now lower than the Diesel and Petrol Carbon Factor. This is why the **UK drive towards the Electrification of Heat and Transport** to assist with reaching Net Zero.

Heat pumps are up to 300% efficient and gas condensing boilers 96% efficient which means it is already now less 'carbon intensive' to heat buildings with electric heat pumps instead of gas boilers.
The on-site production of electricity with gas Combined Heat and Power (CHP) plants is no longer attractive from a carbon perspective.

Current Scope 1 and 2 Carbon Emissions vs 2008-09 baseline:

		08-09		20-21 *		Current Estates	Existing Estates
Electricity scope 2 only	reduced from	4,507	to	1,564	TCO2e/year	-65%	-74%
Gas scope 1	increased from	2,736	to	2,970	TCO2e/year	+9%	-10%
Fuel Vehicles Fleet scope 1	reduced from	24	to	7	TCO2e/year	-70%	NA
Total Scope 1 and 2	reduced from	**7,267**	to	**4,542**	TCO2e/year	**-38%**	NC

* reporting on 20-21 data because gas usage therefore gas carbon emissions were unusually high in 21-22 (we think owing to all windows open/extra ventilation during heating season to mitigate COVID risks) and we expect to return to 20-21 levels in 22-23.

On-site solar electricity generation

We currently have **4 on-site Solar Photovoltaic systems** installed between 2017 and 2019 at Lakeside, Library North, Library South and Davies roofs. Together these **508m2 solar panels** produce **about 2% of our electricity demand** and bring **£30,000 p.a.** in avoided electricity costs and feed-in-tariff payments.

Green Electricity

Since 2018 100% of the grid electricity we purchase comes only from renewable sources. This is backed by externally verified certification. Nuclear which is a low carbon source but produce radioactive waste isn't used. We pay a premium for this option, which is **financially more attractive than investing in our own on-site renewables**. This **encourage UK investment in renewable production** of electricity (solar, wind, hydro) and **allows us to report zero 'market based' scope 2 electricity carbon emissions** (however carbon reporting usually request the 'location based' method i.e. scope 2 electricity carbon emissions are declared).
Finally, with our current electricity demand, it is not feasible (space wise) to produce 100% of our electricity needs by renewables means (solar panels) on-site. **Whilst we have some potential and must increase our solar electricity production**, **this option offers in the meantime easy and immediate '100% green electricity coverage'**.

Utilities Costs Ratios (FY21/22)

	£/year/m2	£/month	£/day
Electricity	£11	£100,498	£3,304
Gas	£7	£63,203	£2,078
Water	£3	£26,226	£862
Utilities	**£21**	**£189,928**	**£6,244**

Current (pre-energy crisis impact) Utilities Cost vs 2008-09

Overall utilities expenditure has increased in average by only +20% (from £1.6M to £2M) compared to 14 years ago (FY 2008-09) and this would be only +5% if the Estates had not increased in size!

This shows the real positive financial impact of our move to a flexible energy purchasing strategy (Oct 2014) combined with 'invest to save' projects (all of which has been researched / developed / delivered by just one member of staff) in containing in general upward consumption and inflation trends.

This is a true testimony of the sound financial value of employing Energy Managers.

1. Purpose of the report

The purpose of this report is to disseminate data and analysis relative to the University of Roehampton utilities consumption and carbon emissions impact in the 14 years period 2008 to 2022. By publishing our journey and current position we aim this report to assist with the writing of the company's Net Zero Carbon Strategy to 2050.

2. Background

2.1 Baseline year

The last Carbon Management Plan for University of Roehampton (UoR) was approved in 2011 and set a -40% scope 1 and 2 carbon reduction target for 2020, against a 2005 baseline, as it was then required of all HEI by the HEFCE.

In this report we have reset our baseline year to financial year (FY) 2008-09 as it is more accurate and relevant. Indeed, this is the furthest back in time we have good quality utilities consumption and costs data, held centrally in our TEAM Sigma Utilities Billing Software, implemented in 2011. FY08-09 was also just the year before UoR started its journey towards carbon emissions reduction, with its first 'invest to save' projects in summer 2009.

2.2 Accurate Utilities and Carbon data publicly available

In the last 12-14 years, as part of the Estates Management Returns (EMR) to HESA, organisation-level utilities and carbon emissions data have been submitted annually by the company's Energy Manager. It is no longer required to report EMR to HESA. We must not refer to the publicly available energy/carbon/floors areas data for UoR on the HESA website as it has unfortunately not been collated properly and most of it is inaccurate.

This report aim to set the records straight by making accurate utilities/carbon data and analysis for the last 14 years publicly available.

Since October 2020 we are reporting annually utilities and carbon data as part of the Streamlined Energy and Carbon Reporting (SECR) which are publicly available in our Company Report and Finance Statements. The most accurate and comprehensive SECR report and analysis was completed in November 2022 and covers 4 years from FY18-19 to the most recently completed FY21-22.

2.3 Scope 1 and 2 carbon emissions reductions targets

Our 2011 Carbon Management Plan set a -40% scope 1 and 2 carbon reduction target for 2020 against a 2005 (now FY08-09) baseline - have we achieved this ambitious target? This report answer this question.

Our 2019 Enabling Strategies set a -25% scope 1 and 2 carbon reduction per square meter target for 2025 against a FY17-18 baseline – are we on track? This report answer this question.

2.4 Change in the Estates size

The Estates in 2008 was overall unchanged in size until 2015, after which we had several new buildings and refurbishments, summarised as below.

	Number of buildings	GIA Total (m2)	GIA Heated (m2)	vs Baseline
Existing Estates (2008-2014)	56	86,334	83,328	
New Estates (2014 + The Hive)	57	86,410	83,404	0.1%
New Estates (2015 + Chadwick)	60	92,303	89,297	7%
New Estates (2016 + Elm Grove)	61	103,927	100,921	21%
New Estates (2017 + Library) to 2022	62	112,171	109,165	31%

The construction of Chadwick students residences (Sept 2015), Elm Grove students residences (Sept 2016) and a new Library (Sept 2017) increased the existing Estates size by 31%.

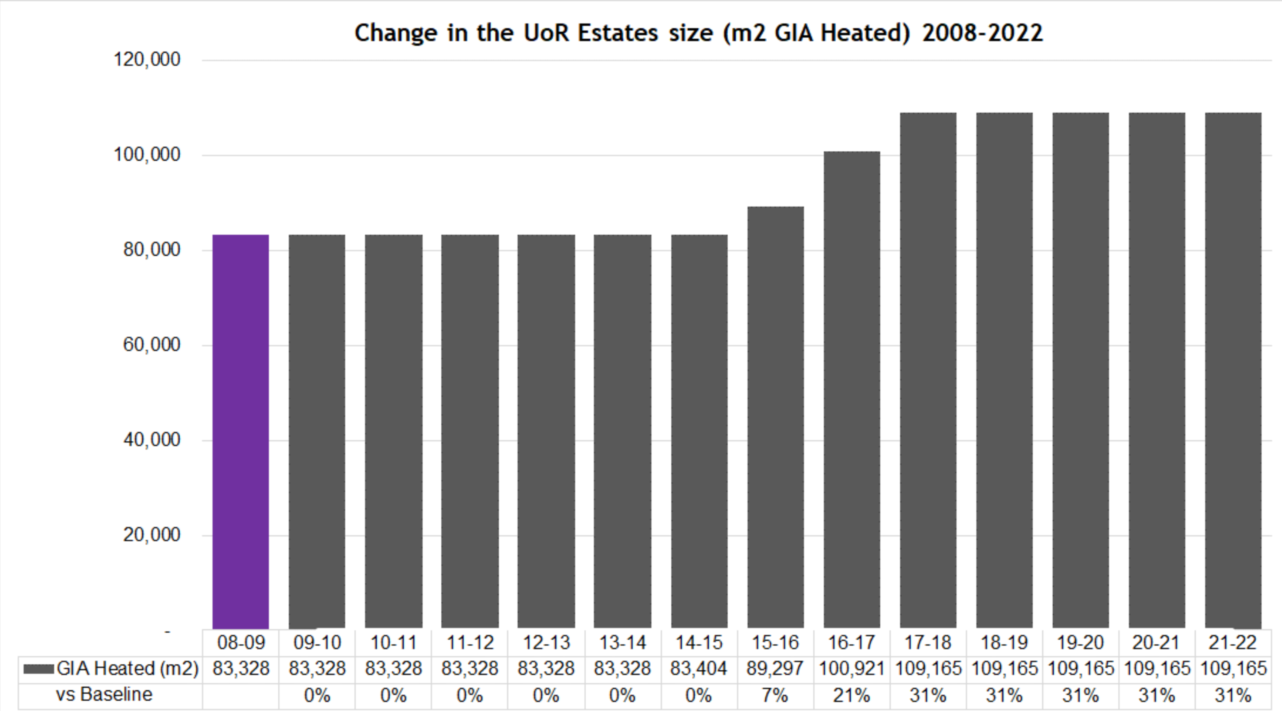


Figure 01 – 2008-2022 Change in the Estates size (m2 GIA Heated)

2.5 How we purchased energy and its impacts

Since October 2014, UoR purchase all its electricity and gas on Flexible Energy Contracts (as opposed to fixed tariff) via an energy broker.

Energy is bought in advance in different proportions, at day-ahead, month-ahead, quarter or season prices, following an agreed Risk Management Strategy.
In a falling wholesale energy market, energy already bought can be sold and bought back at a lower price (refloats). In a rising market, all of the energy is eventually bought to protect a budget, set at ‘mark to market’ (MTM) + 10% ‘capital at risk’.

A flexible energy purchasing strategy targets only the ‘commodity’ element of the price which is normally 60% (gas) and 40% (elec) of a ‘fully delivered price’. The remaining proportion is made up of ‘non-commodity charges’ (network, distribution, metering charges etc.) which are rising and non-negotiable.

The flexible strategy reduce price risk/exposure for an organisation the size of Roehampton. A fixed price contract can be very much described as a ‘russian-roulette approach’ where contracts can be locked-in at a low price as much as have to be renewed at a ‘bad time’ for a 12-24m period (this was the case for UoR during the 2008 energy crisis), and the benefits of a falling market are not passed onto the customer.

The flexible energy purchasing strategy has been hugely beneficial to UoR in the past. For the 4 financials years 2014 to 2018, the gas markets in particular were unusually low and we saved in total over this period well over £500k vs a fixed contract (the equivalent of 1 year of gas expenditure). This is clearly visible in *Figure 22* in this report.

We are currently in an energy prices crisis which started around Sept 2021 with the wholesale markets rising 10 to 17 times higher than usual levels. To put this into context, the last energy crisis (2008) lasted only a few months and saw prices peaking (only) 2 times higher usual levels. These are unprecedented sustained levels.

Whilst the markets have been incredibly high, we have once again benefited from our flexible strategy, 'shielded' until the contracts ends on 30 Sept 2023, as 100% of the energy requirements have been bought pre-crisis.

We have seen a negative impact for the first time on the gas expenditures in FY21-22 (+£227k) and are currently in FY22-23 in a gas costs mitigation scenario, (+£1M possible overspend) due to additional group gas volumes requirements at inflated markets times.

However without the flex strategy, we would have immediately been impacted by the energy crisis: electricity and gas would have respectively costs us an additional £4million and £2.5million, in the Oct 2020-Oct 2023 period.

Our energy expenditure which has been for the last 14 years in the range £1.2M - £1.8M p.a., (elec £1.2M; gas £0.6M), is currently (Sep 2022) forecasted to dramatically increase to about £5M p.a. in total, about £3M for electricity and £2M for gas for FY23-24.

3. Foreword

3.1 How to read these graphs

To make reading easier, a few graphics choices have been made consistent to all graphs.

- Electricity is always represented in green (except baseline and average bars).
- **Gas** is always represented in **red** (except baseline and average bars).
- **Water** is always represented in **blue** (except baseline and average bars).
- **Baseline**: the 2008/09 baseline (bar or line) of all graphs is represented in **purple**.
- **Average**: the last 5 years average (FY2017 to 2022) of all graphs is represented in **black**.
- **New Estate**: Chadwick + Elm Grove + Library combined values are represented in **orange**.
- Utilities: Energy (Electricity + Gas) or Utilities (Electricity + Gas + Water) combined values are represented in yellow.

All graphs usually have the 'X axis' with years 1 August 2008 to 31 July 2009 (08-09) to 1 August 2021 to 31 July 2022 (21-22), with a 'Data Table' underneath providing each values, and % variation for each year (inc. last 5 years average values) against the 08-09 baseline values.

We aimed to present as much as possible valuable information in a condensed and visual format.

3.2 Data sources

3.2.1 <u>Gross Internal floors Areas (GIA) data</u>

For a definition of GIA, see Glossary in Appendix. The Gross Internal floors Areas (GIA) data of the UoR Estates is the result of a long awaited and time consuming internal review (2020-2022) of all AutoCAD buildings drawings and update in our Invida platform to extract the data.

Huge thanks to Gary Munro, Project Officer in the Estates and Campus Services Department for his hard work and commitment to improve the data quality of these important records for the University (which were unfortunately historically largely inaccurate in parts).

The review was c.90% complete as of July 2022 (data used in this report) i.e. Southlands residences, Mount Clare residences and Lee House use unverified historical (c.2009) GIA records.

A summary of GIA per building is in appendix. This is the most up-to-date/accurate GIA Asset List available from the Estates Department of UoR Buildings.

For ratios (such as kWh or £/m2) presented in this report we use the GIA 'Heated' data. This is a crude/simplified result of 'serviced space' (heated and/or air-conditioned) with the simple exclusion of some buildings loft and basements floors areas in the data set that we know unoccupied/unserved.

3.2.2 Utilities consumption and costs data

Grid Electricity, Gas and Water Consumption and Costs data are from the Company's Utilities Software (TEAM Sigma) as inputted by an outsourced Bureau Service (TEAM Energy Bureau) from the company's electronic (.EDI) utilities invoices and as exported from the software by TEAM Bureau Services Delivery Manager (Matthew Cooper or Lauren Meade).

3.2.3 Data quality and amendments

All utilities readings are actuals thanks to Automatic Meter Reading (AMR) devices at each fiscal meter. Consumption data has been amended where known metering issues has resulted in the consumption billed and held in the software known as not accurate. Usually we have taken the 'nearest in time' average reliable data to infill gaps or replace data sets. Notes of data amendments are in appendix.

3.2.4 Diesel and Petrol Vehicles Fuel usage data

Diesel and Petrol usage data are from the Company's Fuel provider as extracted by the Company's Energy Manager from their online platform "WebFuel" as part of EMR and SECR annual submissions. Since 2021 they have a new platform "RadiusVelocity".

3.2.5 On-site Solar Electricity Generation data

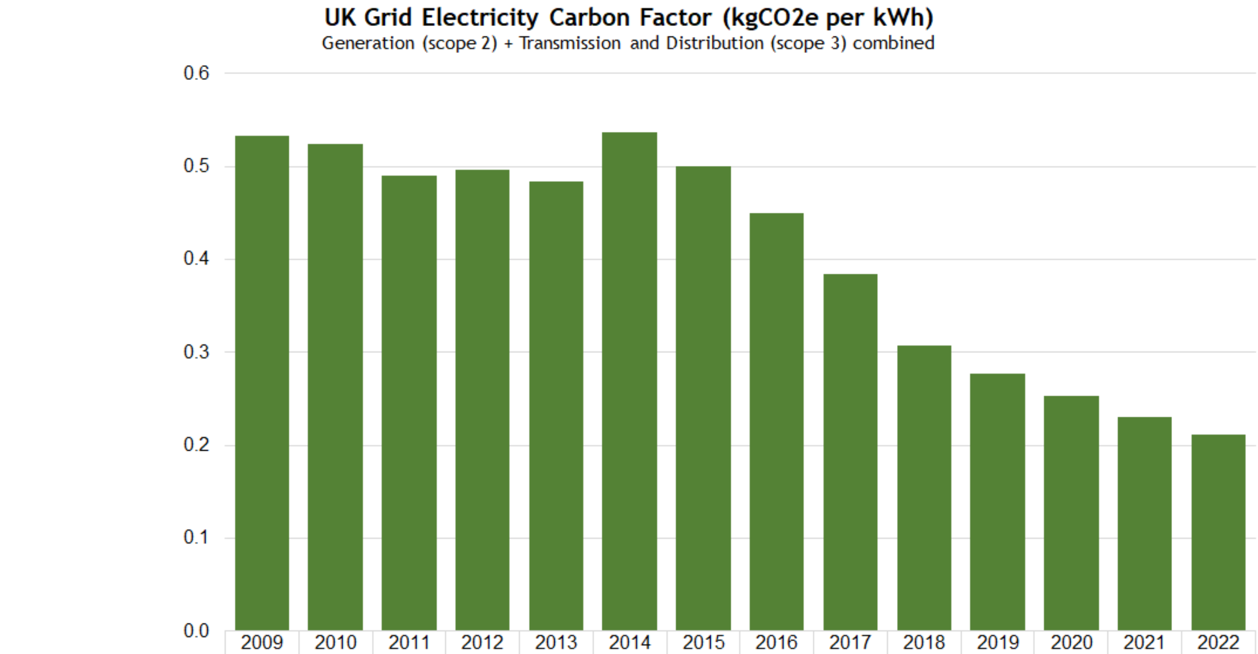
On-site Solar Electricity Generation data are currently from quarterly manual readings of the generation meters, inputted by the Company's Energy Manager into a spreadsheet.

3.2.6 Utilities Carbon Factors

For a definition of what Carbon Factors are, see Glossary in Appendix.
The government conversion factors for greenhouse gas reporting 'Carbon Factors' are the latest updated factors (at the time of writing this report) to use in the UK, from the Department for Business, Energy and Industrial Strategy (BEIS) and available at:
https://www.gov.uk/government/collections/government-conversion-factors-for-company-reporting

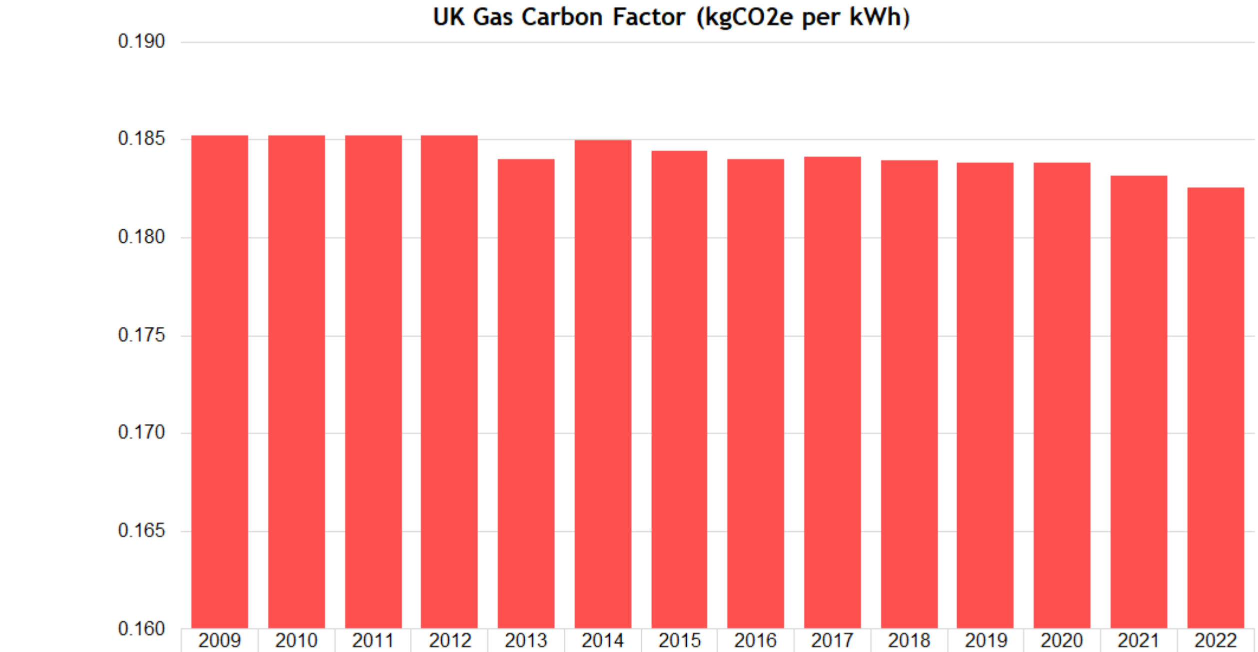
We have produced the graphs below to summarise the values used and show how the carbon factors have varied over the period 2009-2022.

As we can see below, the generation of electricity in the UK is overall 60% less 'carbon intensive' than 14 years ago, as the country have taken useful steps to decarbonise its production such as more offshore wind and nearly zero coal. There are plans and capacity to further decarbonise the production of electricity.



	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Electricity Carbon Factor	0.533	0.524	0.491	0.496	0.484	0.537	0.500	0.449	0.384	0.307	0.277	0.253	0.231	0.211
vs Baseline		-2%	-8%	-7%	-9%	1%	-6%	-16%	-28%	-42%	-48%	-52%	-57%	-60%

Figure 02 – 2009-2022 UK Carbon Factor: Electricity (kgCO2e/kWh)

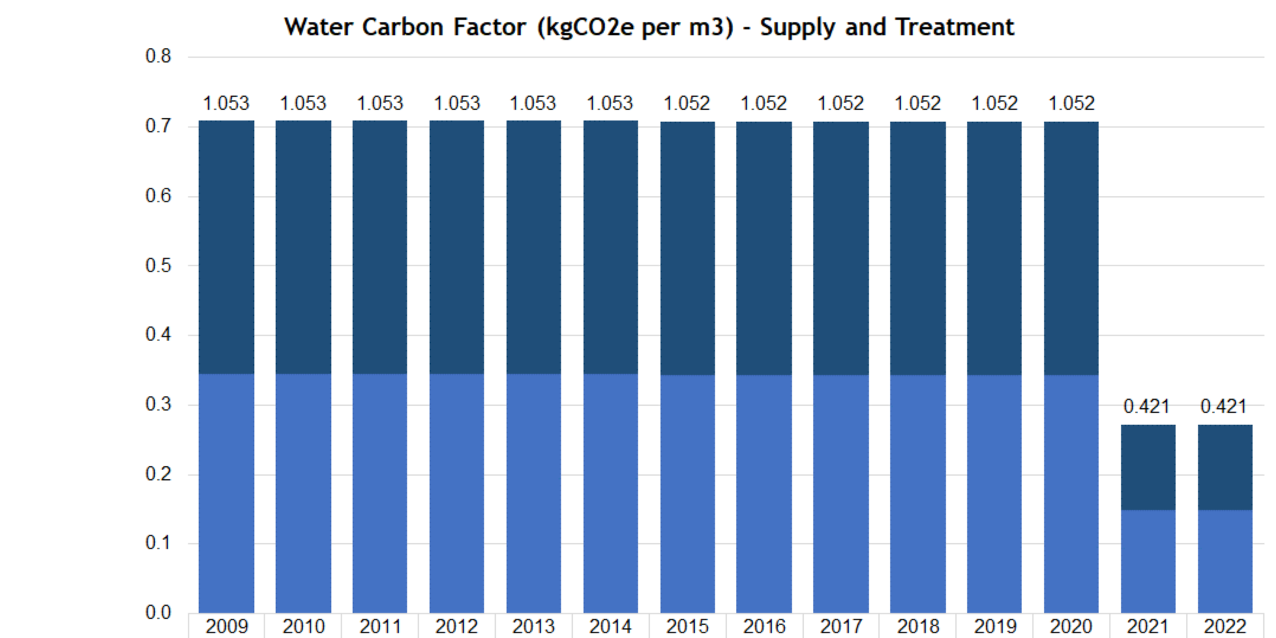


	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Gas Carbon Factor	0.185	0.185	0.185	0.185	0.184	0.185	0.184	0.184	0.184	0.184	0.184	0.184	0.183	0.183
vs Baseline		0.0%	0.0%	0.0%	-0.6%	-0.1%	-0.4%	-0.7%	-0.6%	-0.7%	-0.7%	-0.7%	-1.1%	-1.4%

Figure 03 - 2009-2022 UK Carbon Factor: Gas (kgCO2e/kWh)

The Gas Carbon Factor is virtually the same than 14 years ago. Indeed the decarbonisation of the gas grid is more challenging - the injection of green gas such as biomethane is currently encouraged but limited.

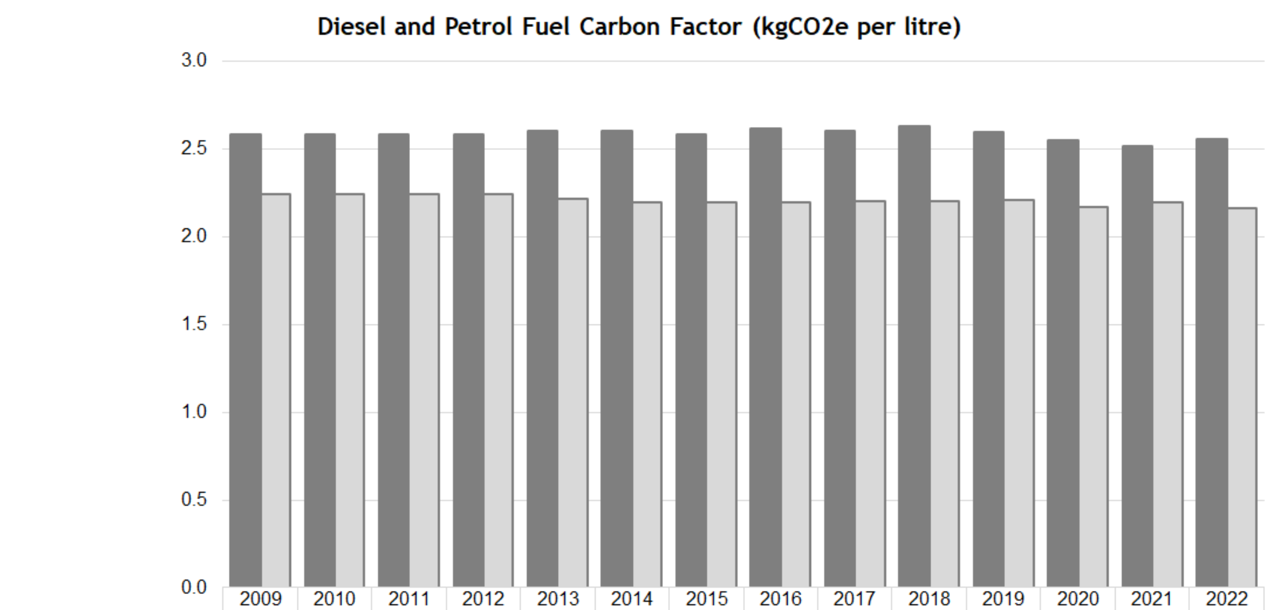
The electricity carbon factor (at 0.21) is now very close to the gas carbon factor (at 0.18). This means that because heat pumps are up to 300% efficient (i.e. 300 units of heat obtained for 100 units of electricity used) and the most efficient gas condensing boilers are ‘only’ 96% efficient (i.e. 96 units of heat obtained for 100 units of gas used), it is already much less ‘carbon intensive’ to switch heating buildings with electric heat pumps instead of gas boilers. The local production of electricity with gas CHP is now much less attractive from a carbon perspective.



	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Water Treatment	0.709	0.709	0.709	0.709	0.709	0.709	0.708	0.708	0.708	0.708	0.708	0.708	0.272	0.272
Water Supply	0.344	0.344	0.344	0.344	0.344	0.344	0.344	0.344	0.344	0.344	0.344	0.344	0.149	0.149
vs Baseline		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-60%	-60%

Figure 04 - 2009-2022 UK Carbon Factor: Water Supply and Treatment (kgCO2e/m3)

The combined Carbon Factor associated to the supply of water and treatment of wastewater in the UK has reduced by 60% from 1.053 to 0.421 kgCO2e/m3. The sudden reduction is due to an update from 2021 in the data source used by BEIS to calculate these factors that takes into account the decarbonisation of the UK grid (electricity is used for water supply and treatment)[5].



	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Diesel Carbon Factor	2.58	2.58	2.58	2.58	2.60	2.60	2.58	2.61	2.60	2.63	2.59	2.55	2.51	2.56
Petrol Carbon Factor	2.24	2.24	2.24	2.24	2.21	2.19	2.19	2.20	2.20	2.20	2.21	2.17	2.19	2.16
vs Baseline Diesel		0%	0%	0%	1%	1%	0%	1%	1%	2%	0%	-1%	-3%	-1%
vs Baseline Petrol		0%	0%	0%	-1%	-2%	-2%	-2%	-2%	-2%	-1%	-3%	-2%	-4%

Figure 05 - 2009-2022 UK Carbon Factor: Diesel and Petrol Fuel (kgCO2e per litre)

[5] From BEIS: "The water supply and water treatment factors are now calculated based on the 2020 data from the UK water companies Carbon Accounting Workbooks (CAW). This is because previously the values were coming from a publication of the UK water industry from 2012 that has now been discontinued. There is a large decrease in the conversion factors associated with water supply and water treatment compared to last year's conversion factors. This is most likely due to the updated method reflecting the grid decarbonisation since 2012."

The Diesel and Petrol Carbon Factors are ever so slightly lower at respectively -1% and -4% but virtually the same than 14 years ago. Although not to be encouraged as a measure, as both are fossils fuels to move away from, according to this data, Petrol at 2.16 kgCO2e/litres is 15% less polluting than Diesel at 2.56 kgCO2e/litres, if the same quantities are used as a vehicles' fuel.

With the exception of the electricity carbon factors, these factors only clearly go back to 2012. In order to calculate our carbon footprint these years, we have therefore estimated for the 3 years 2009-2011 the same factors than 2012 for gas, water and diesel/petrol. This seems a very valid approach as subsequent years to 2012 do not show massive variations.

3.2.7 How are Carbon Emissions calculated?

Carbon emissions (in TCO2e) are worked out by multiplying a quantity of utilities (kWh of energy or m3 of water) by the relevant annual carbon factor (in kgCO2e/kWh or kgCO2e/m3).

3.2.8 How are average prices calculated?

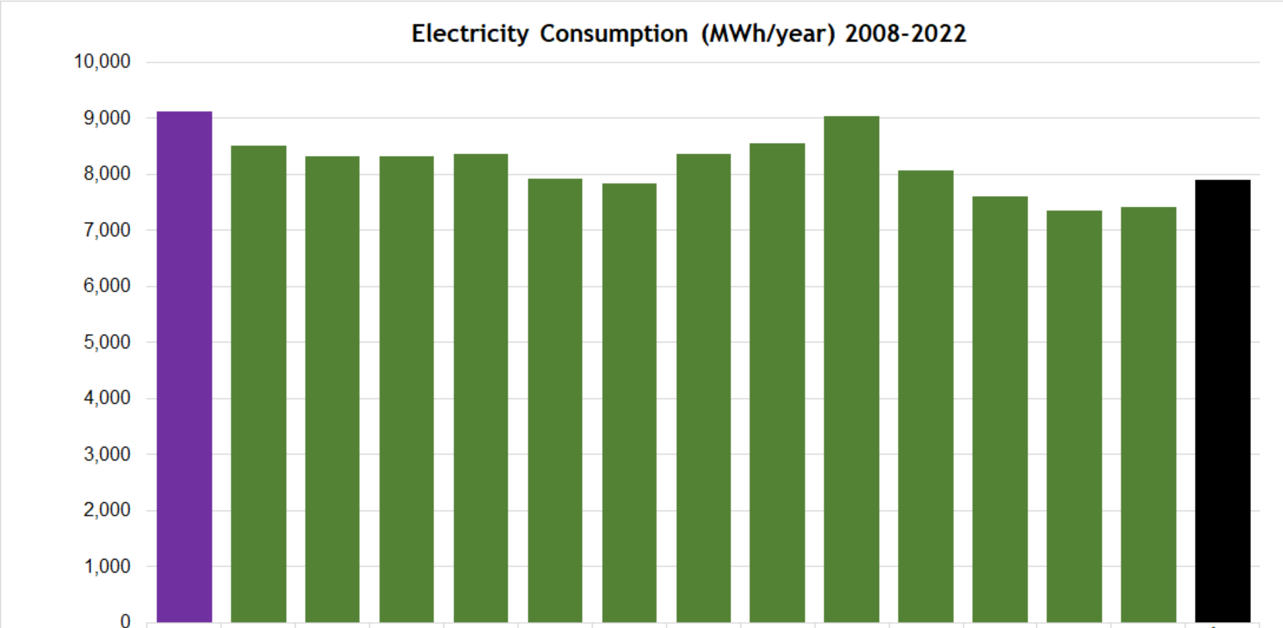
The average cost of each utility at UoR is worked out by dividing total expenditure inc. VAT by total consumption, for each financial year.

3.3 Analysis boundaries

This report intentionally focuses on analysis at organisation level with an annual breakdown of data. We aim to publish later in separate reports further useful utilities analysis, such as average monthly profiles of consumption and costs and also an estimated breakdown of utilities consumption, costs and carbon emissions per building.

4. ELECTRICITY

4.1 Electricity Consumption analysis



	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Avg 17-22
MWh / year	9,127	8,517	8,333	8,319	8,371	7,925	7,843	8,363	8,566	9,039	8,075	7,608	7,366	7,426	7,903
vs Baseline		-7%	-9%	-9%	-8%	-13%	-14%	-8%	-6%	-1%	-12%	-17%	-19%	-19%	-13%

Figure 06 – 2008-2022 Electricity Consumption (MWh/year)

As we can see in *Figure 06*, in 2021/22 annual electricity consumption was 19% lower (at 7426 MWh/year) than in our baseline year 2008/09 (at 9127 MWh/year).

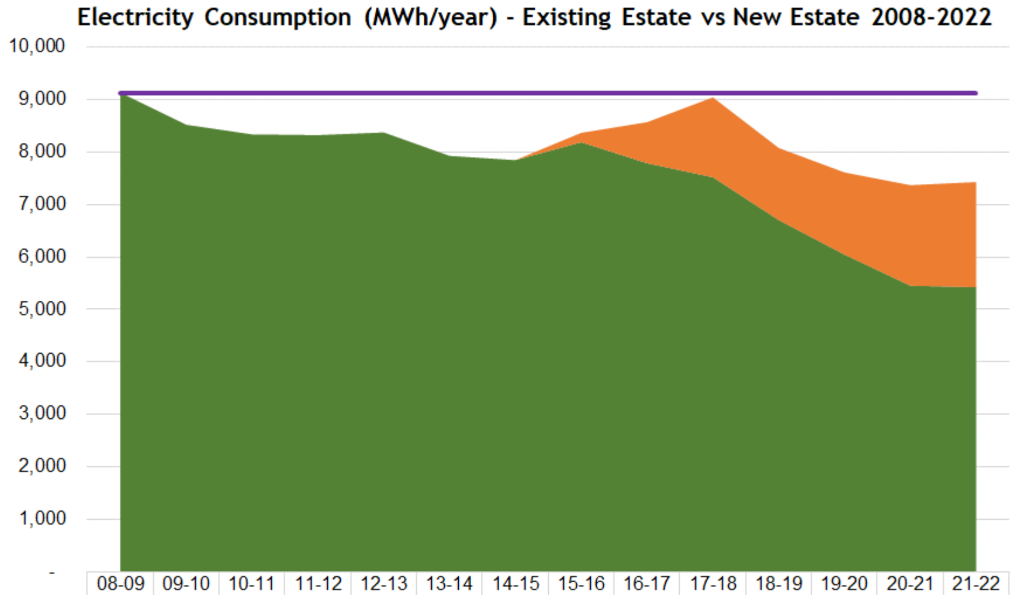
There are many use of electricity and many factors will have a positive/negative influence, some we have some control over, some we don't really ; some activities may have had a significant enough impact that we are not even aware of or unquantifiable.

Having said that, there is definitively a sustained trend visible at organisation level for a reduction in electricity usage. The last 5 years (2017-22) average electricity usage was 13% lower than in 2008/09.

The overall electricity consumption reduction is the University biggest achievement in term of utilities reduction and is thought to be the direct positive result of the company's continuous investments towards more energy efficient electrical equipment – voltage optimisation and LED lighting in particular.
The reduction of our on-site Data Centre to move to cloud-based and computer virtualisation over the last decade may have had a positive impact too (we do not have data to quantify this).

In the 2 years period from August 2009 to 2011, voltage optimisation equipment had been installed on all 7 main electrical supplies. Energy analysis showed that typically the technology saved 8-9% electricity on the entire incoming electric supply.

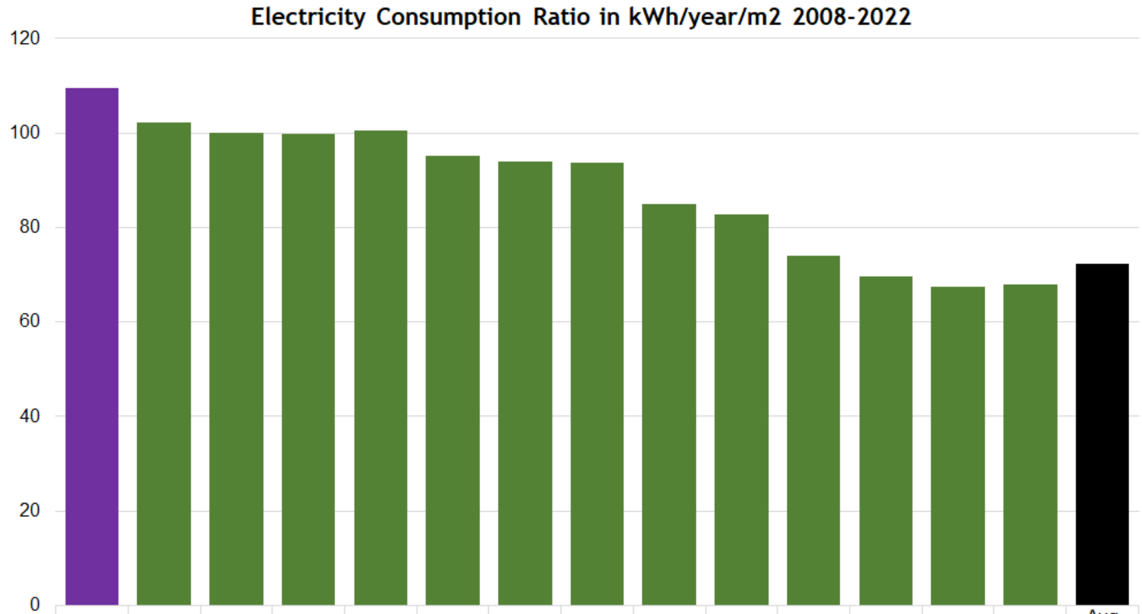
In the 12 years period from 2010 to 2022, we have replaced in total over 14,000 luminaires to quality long lasting energy efficient LED lighting, with daylight and movements sensors, wherever appropriate. Energy monitoring showed that typically each project reduces electricity used for lighting by 80%. Lighting outputs/quality/aesthetics/fit for purpose and emergency lighting compliance was much improved in all projects. See "*11.Utilities Savings and Management: Completed Projects 2010 – 2022*" below for further details.



	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22
New Estate (MWh/year)	-	-	-	-	-	-	-	179	780	1,521	1,372	1,564	1,913	2,003
Existing Estate (MWh/year)	9,127	8,517	8,333	8,319	8,371	7,925	7,843	8,184	7,786	7,517	6,703	6,044	5,453	5,423
Baseline (MWh/year)	9,127	9,127	9,127	9,127	9,127	9,127	9,127	9,127	9,127	9,127	9,127	9,127	9,127	9,127
vs Baseline (Existing Estate only)		-7%	-9%	-9%	-8%	-13%	-14%	-10%	-15%	-18%	-27%	-34%	-40%	-41%

Figure 07 - 2008-2022 Electricity Consumption (MWh/year) – Existing Estate vs New Estate

The absolute reduction in electricity usage is real cause for 'celebration' – that is despite a +31% increase in the size of the Estates. As we can see in *Figure 07*, looking at the same size Estates (Existing Estate) electricity usage is -41% lower in 21/22 vs 08/09 !

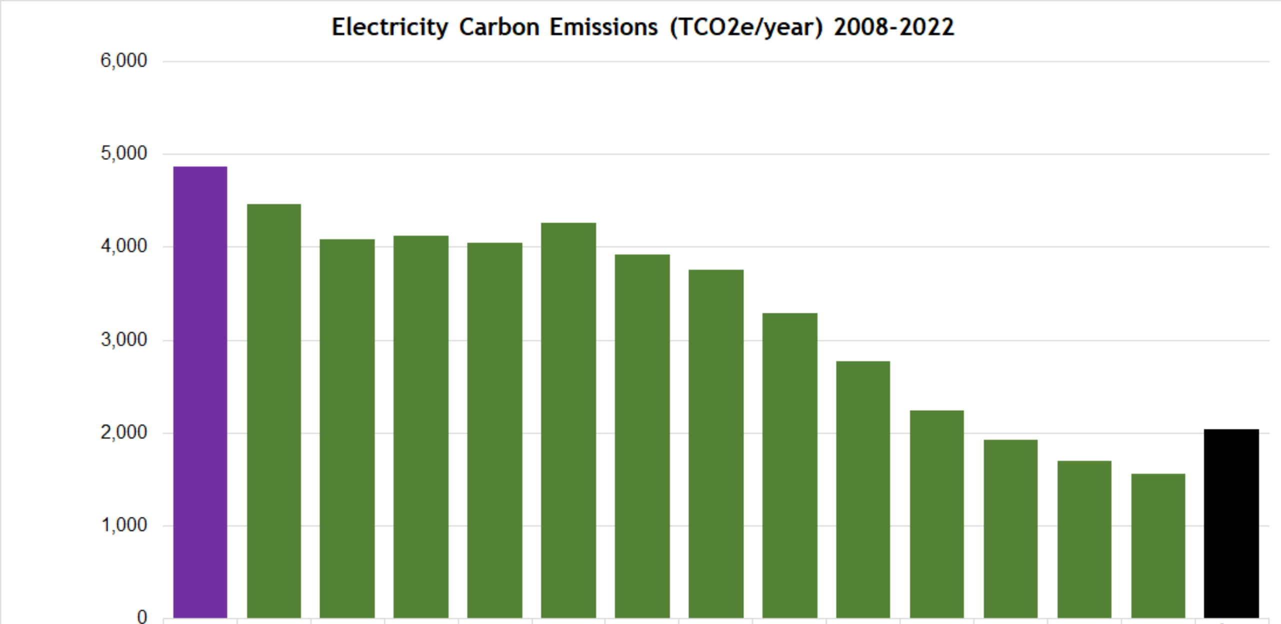


	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Avg 17-22
kWh / year / m2	110	102	100	100	100	95	94	94	85	83	74	70	67	68	72
vs Baseline		-7%	-9%	-9%	-8%	-13%	-14%	-14%	-23%	-24%	-32%	-36%	-38%	-38%	-34%

Figure 08 - 2008-2022 Electricity Consumption Ratio in kWh/year/m2

A steady and continued reduction in electricity consumption trend is clearly visible in *Figure 08*. In relative terms, we used -38% less electricity in 21-22 (at 68 kWh/year/m2) and -34% less in average over the last 5 years (at 72 kWh/year/m2) vs 08-09 baseline (at 110 kWh/year/m2).

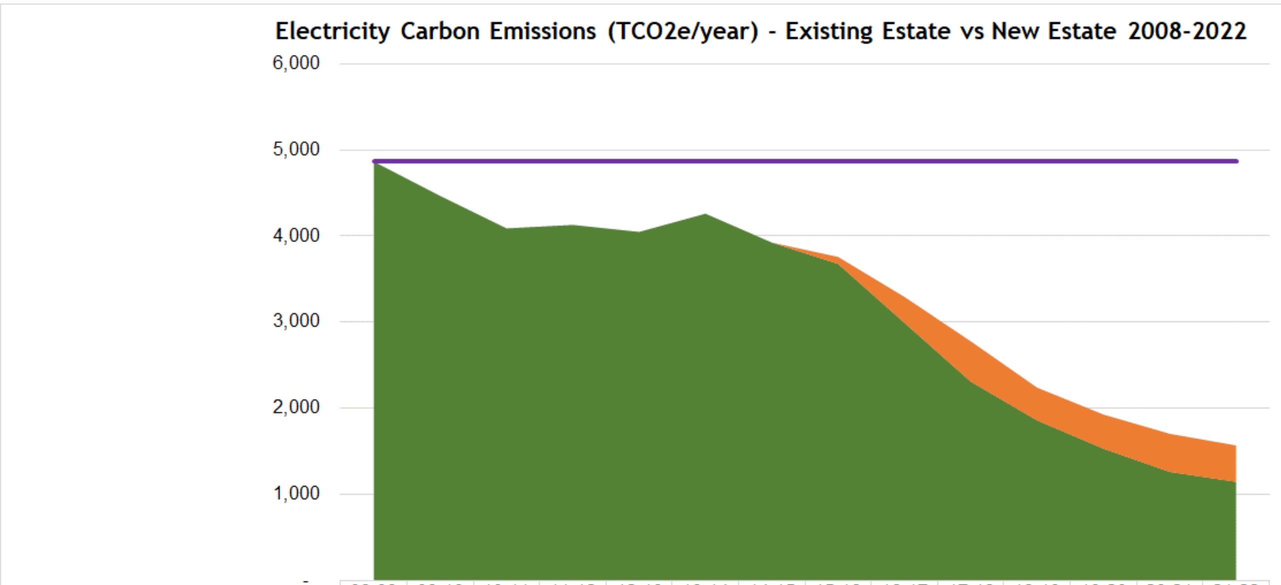
4.2 Electricity Carbon emissions analysis



	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Avg 17-22
TCO2e / year	4,864	4,466	4,089	4,129	4,048	4,259	3,924	3,758	3,293	2,777	2,239	1,926	1,702	1,567	2,042
vs Baseline		-8%	-16%	-15%	-17%	-12%	-19%	-23%	-32%	-43%	-54%	-60%	-65%	-68%	-58%

Figure 09 - 2008-2022 Electricity Carbon Emissions (TCO2e/year)

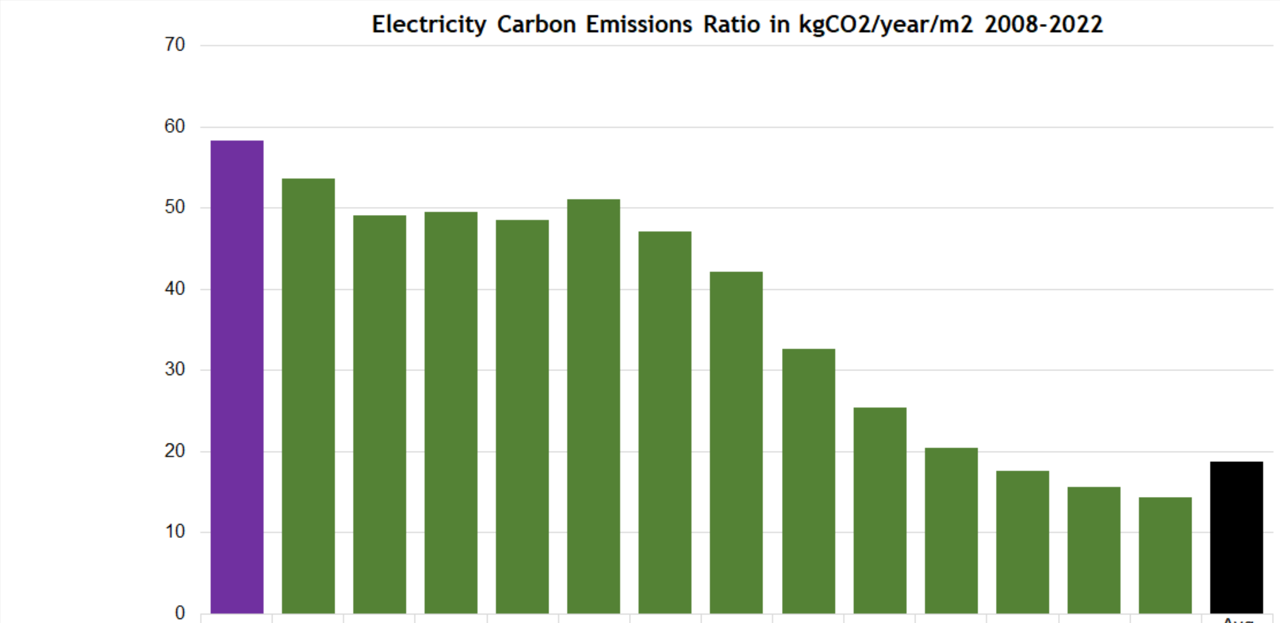
As we have seen, in the period 2008-2022, electricity usage has reduced by -19% (in absolute terms) and the electricity carbon factor (how much carbon emissions is to be associated with the use of 1kWh of grid electricity in the UK) has reduced by -60%. As a result of these two positives trends, the company's associated carbon emissions for its use of grid electricity are -68% lower in 21/22 (1567 TCO2e) than in 08/09 (4864 TCO2e), as shown in Figure 09.



	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22
New Estate (TCO2e/year)	-	-	-	-	-	-	-	80	300	467	380	396	442	423
Existing Estate (TCO2e/year)	4,864	4,466	4,089	4,129	4,048	4,259	3,924	3,677	2,993	2,309	1,859	1,530	1,260	1,145
Baseline (TCO2e/year)	4,864	4,864	4,864	4,864	4,864	4,864	4,864	4,864	4,864	4,864	4,864	4,864	4,864	4,864
vs Baseline (Existing Estate only)		-8%	-16%	-15%	-17%	-12%	-19%	-24%	-38%	-53%	-62%	-69%	-74%	-76%

Figure 10 - 2008-2022 Electricity Carbon Emissions (TCO2e/year) - Existing Estate vs New Estate

As we can see in Figure *10*, looking at the same size Estates (Existing Estate) carbon emissions associated to grid electricity usage are -76% lower in 21/22 vs 08/09 !

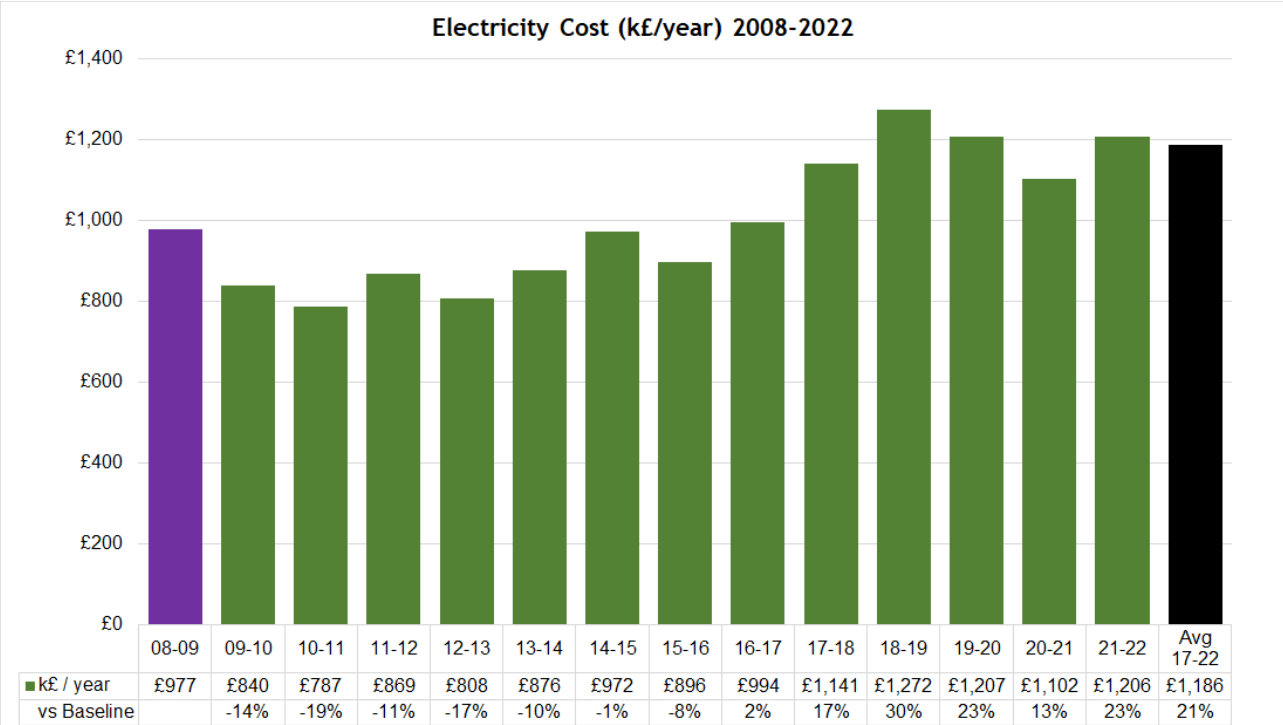


	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Avg 17-22
kgCO2e / year / m2	58	54	49	50	49	51	47	42	33	25	21	18	16	14	19
vs Baseline		-8%	-16%	-15%	-17%	-12%	-19%	-28%	-44%	-56%	-65%	-70%	-73%	-75%	-68%

Figure 11 - 2008-2022 Electricity Carbon Emissions Ratio in kgCO2e/year/m2

In relative terms, we emitted -75% less carbon emissions associated to our use of grid electricity in 21-22 (at 14 kgCO2e/year/m2) vs 08-09 baseline (at 58 kgCO2e/year/m2).

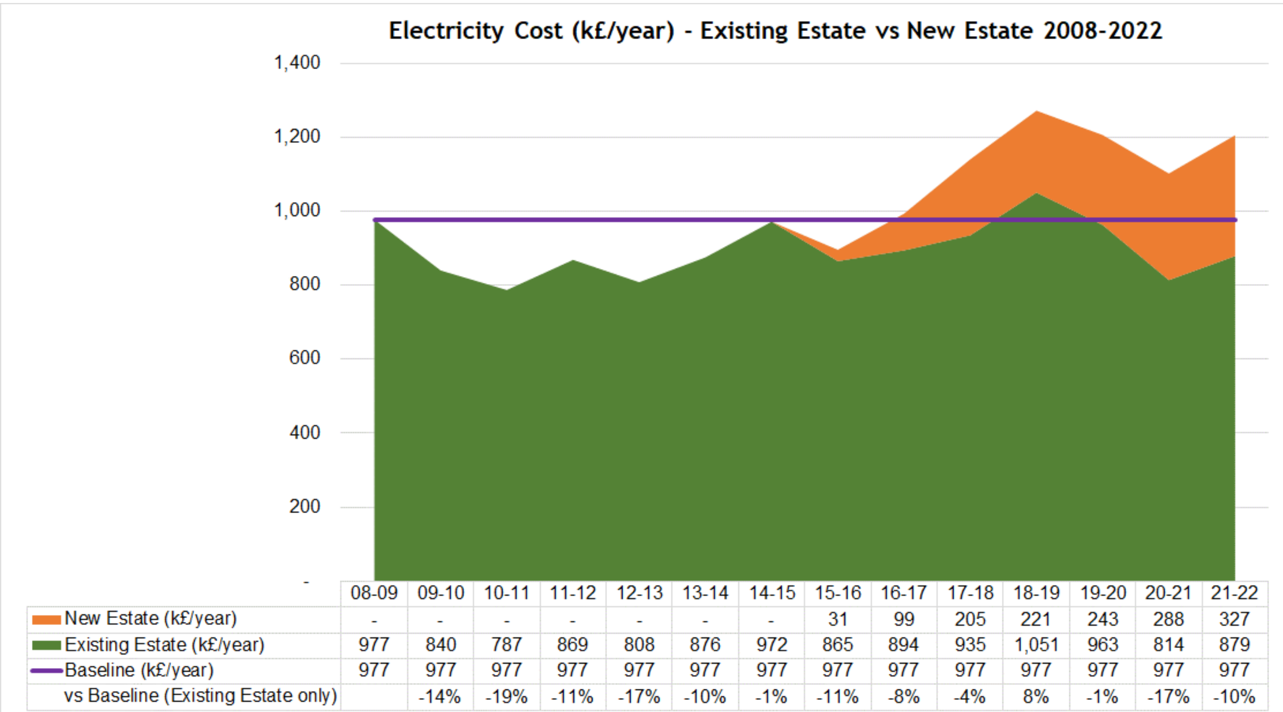
4.3 Electricity Costs analysis



	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Avg 17-22
k£ / year	£977	£840	£787	£869	£808	£876	£972	£896	£994	£1,141	£1,272	£1,207	£1,102	£1,206	£1,186
vs Baseline		-14%	-19%	-11%	-17%	-10%	-1%	-8%	2%	17%	30%	23%	13%	23%	21%

Figure 12 - 2008-2022 Electricity Cost (k£/year)

At its lowest point in the last 14 years, electricity expenditure was under £800k p.a. (Figure *12*). Despite a 52% rise in electricity prices (Figure *14*) and thanks to the -19% absolute reduction in electricity consumption despite the increase in the size of the Estates (*Figure 06*), electricity expenditure is only currently +23% higher (at £1.2M p.a) than 14 years ago.

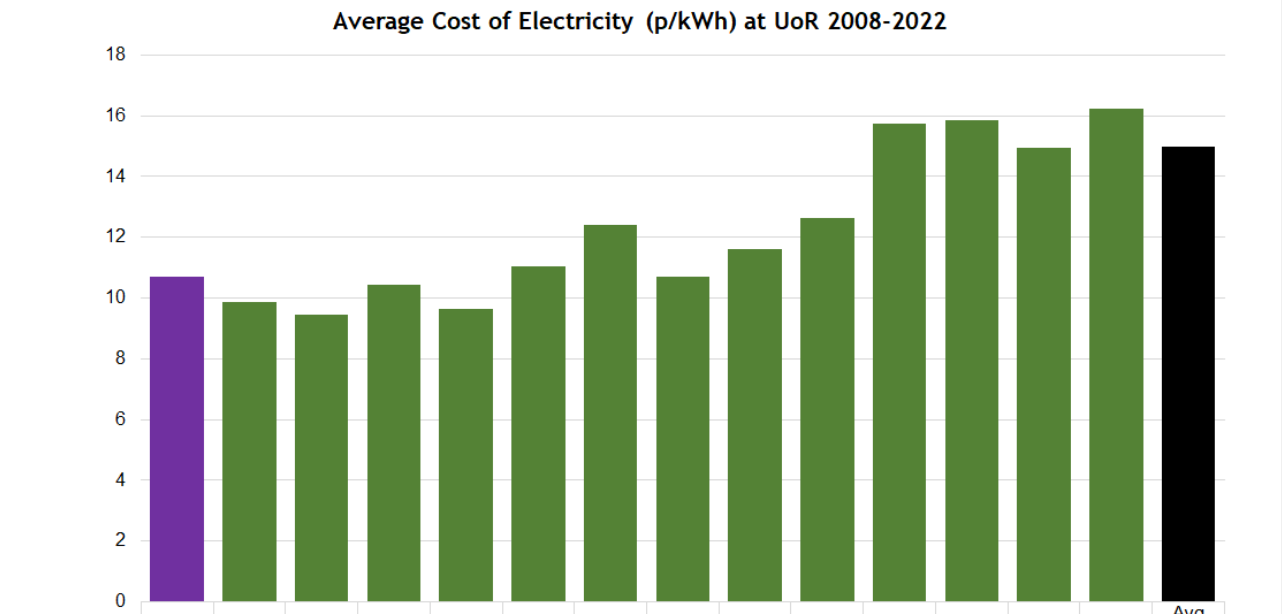


	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22
New Estate (k£/year)	-	-	-	-	-	-	-	31	99	205	221	243	288	327
Existing Estate (k£/year)	977	840	787	869	808	876	972	865	894	935	1,051	963	814	879
Baseline (k£/year)	977	977	977	977	977	977	977	977	977	977	977	977	977	977
vs Baseline (Existing Estate only)		-14%	-19%	-11%	-17%	-10%	-1%	-11%	-8%	-4%	8%	-1%	-17%	-10%

Figure 13 - 2008-2022 Electricity Cost (k£/year) – Existing Estate vs New Estate

As we can see above in Figure *13* should we have the same Estates size, and despite the rise in electricity prices, our electricity expenditure would actually be currently -10% lower than 14 years ago!

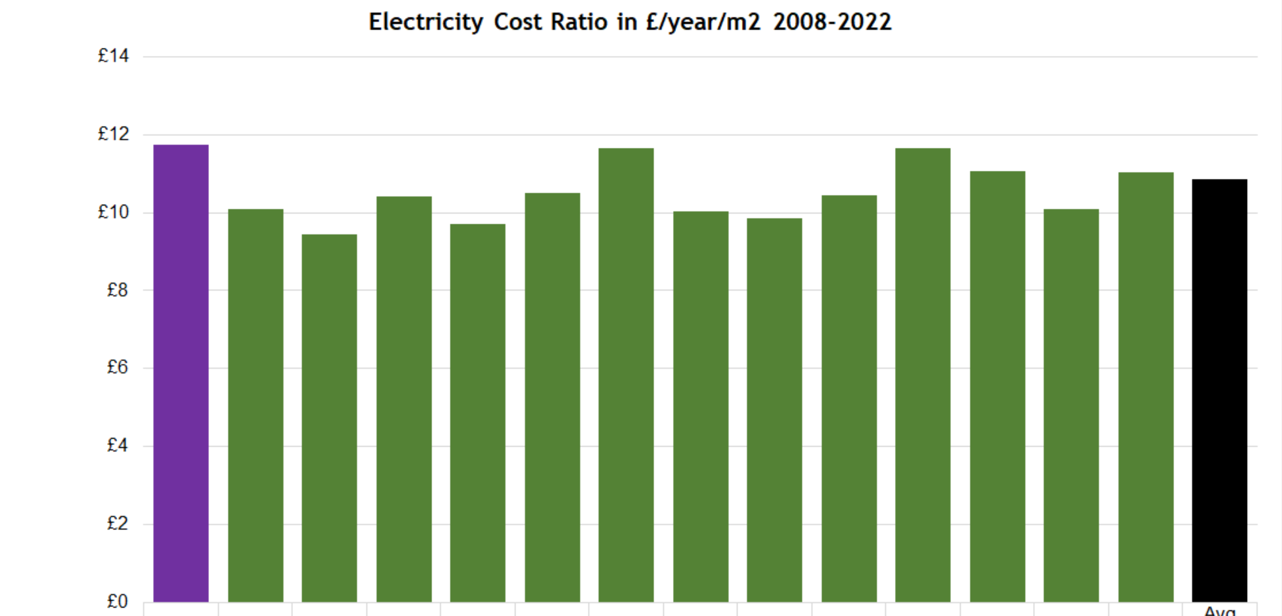
That results are visible for a large organisation the size of UoR to the point active energy management has compensated substantial increase in units rates to maintain a similar electricity expenditure on such a long period is an achievement and true testimony of its benefits.



	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Avg 17-22
p/kWh	10.7	9.9	9.4	10.4	9.7	11.0	12.4	10.7	11.6	12.6	15.8	15.9	15.0	16.2	15.0
vs Baseline		-8%	-12%	-2%	-10%	3%	16%	0%	8%	18%	47%	48%	40%	52%	40%

Figure 14 - 2008-2022 Average Cost of Electricity at UoR (p/kWh)

The average cost of electricity at UoR was 9.4p/kWh at its lowest point (FY10-11) and is now 16.2p/kWh, a +52% increase on the 10.7p/kWh we were paying 14 years ago.



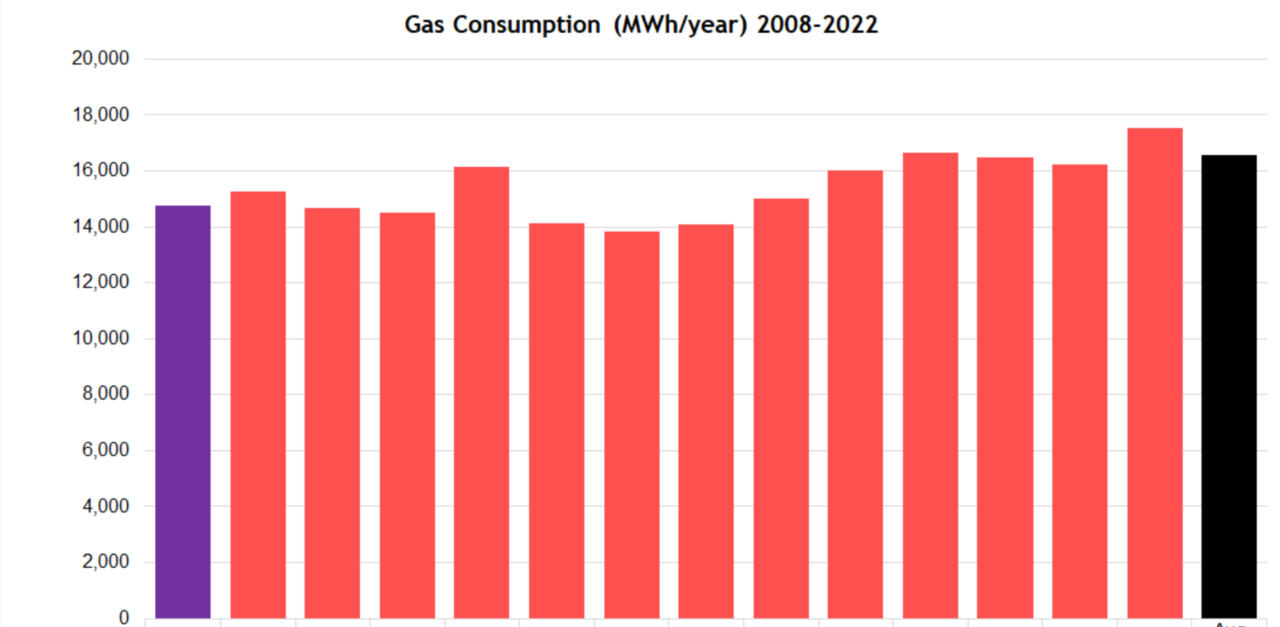
	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Avg 17-22
£ / year / m2	£12	£10	£9	£10	£10	£11	£12	£10	£10	£10	£12	£11	£10	£11	£11
vs Baseline		-14%	-19%	-11%	-17%	-10%	-1%	-14%	-16%	-11%	-1%	-6%	-14%	-6%	-7%

Figure 15 - 2008-2022 Electricity Cost Ratio in £/year/m2

In average, each m2 of building cost us £11/year in electricity.

5. GAS

5.1 Gas Consumption analysis



	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Avg 17-22
MWh / year	14,773	15,264	14,694	14,506	16,163	14,150	13,830	14,067	15,009	16,016	16,653	16,477	16,218	17,517	16,576
vs Baseline		3%	-1%	-2%	9%	-4%	-6%	-5%	2%	8%	13%	12%	10%	19%	12%

Figure 16 – 2008-2022 Gas Consumption (MWh/year)

As we can see in *Figure 16*, in 2021/22 annual gas consumption was +19% higher (at 17,517 MWh/year) than in our baseline year 2008/09 (at 14,773 MWh/year).

The overall gas consumption increase, as we can see in *Figure 17*, seems to be predominantly due to the increase in the size of the Estates. The spike in 21/22, is thought to be due as a direct negative result of the COVID mitigations ventilation requirements for leaving windows open during all of the winter period, whilst heating was on.

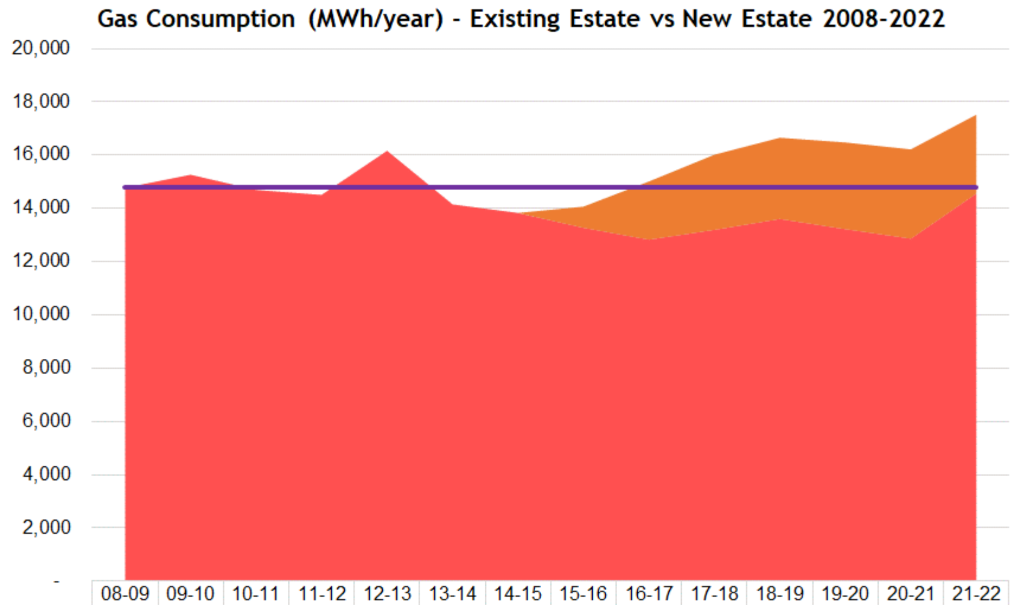
Whilst we have 700 students' bedrooms heated by electric radiators, gas fed Combined Heat and Power (CHP) plants at Chadwick and Elm Grove and electric heat pumps in David Bell building (refurbished 2020), the vast majority of UoR buildings are heated with traditional gas boilers.

Space heating is estimated to account for 70% of gas usage, with hot water, combined heat and power (CHP), and catering for the remaining proportion.

Please note, the gas consumption data is not 'weather adjusted', so for the proportion used for space heating, usage would naturally vary year on year, depending on how cold the winter was. Operational issues with gas boilers, heating settings adjustments and gas leaks can all have a large influence too.

To save gas/heating we have:
- draught-proofed 650 windows and doors
- installed/replaced in total 1750 thermostatic radiators valves in 25 buildings
- installed over 4000m2 of insulation in 8 buildings lofts
- installed the equivalent of 1200 metres of pipework insulation in 12 boilers rooms
- detected and repaired several gas leaks
- adjusted heating levels/timings where possible.

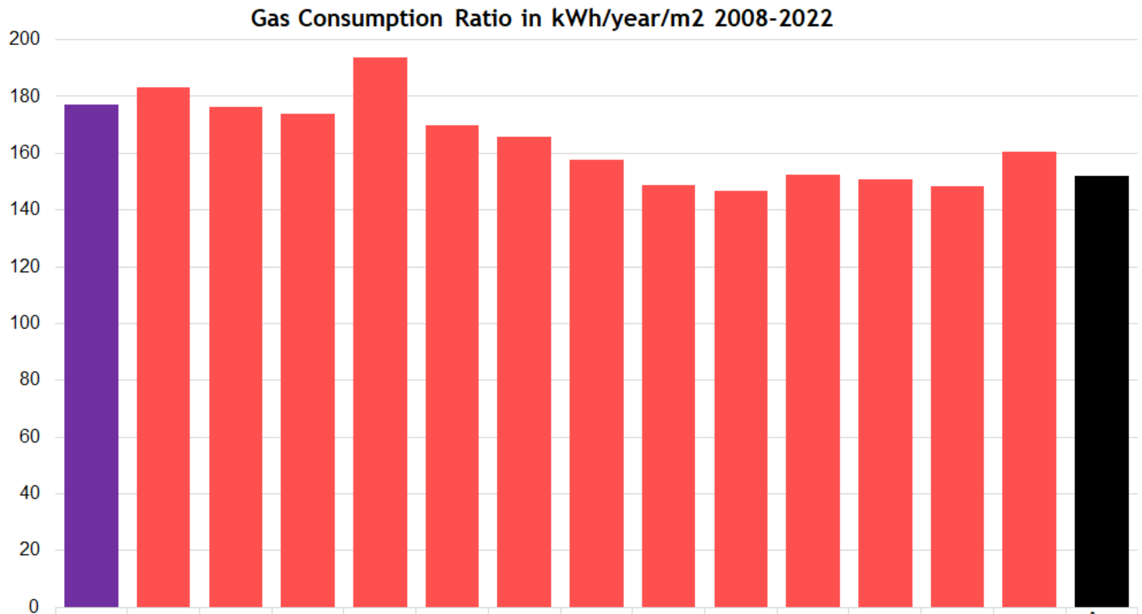
See "*11.Utilities Savings and Management: Completed Projects 2010 – 2022*" for further details.



	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22
New Estate (MWh/year)	-	-	-	-	-	-	-	794	2,183	2,823	3,048	3,254	3,352	2,957
Existing Estate (MWh/year)	14,773	15,264	14,694	14,506	16,163	14,150	13,830	13,274	12,827	13,194	13,605	13,223	12,865	14,560
Baseline (MWh/year)	14,773	14,773	14,773	14,773	14,773	14,773	14,773	14,773	14,773	14,773	14,773	14,773	14,773	14,773
vs Baseline (Existing Estate only)		3%	-1%	-2%	9%	-4%	-6%	-10%	-13%	-11%	-8%	-10%	-13%	-1%

Figure 17 – 2008-2022 Gas Consumption (MWh/year) – Existing Estate vs New Estate

As we can see in Figure *17*, looking at the same size Estates (Existing Estate) gas usage was globally -10% lower in the period 2015-2021 vs 2008/09.

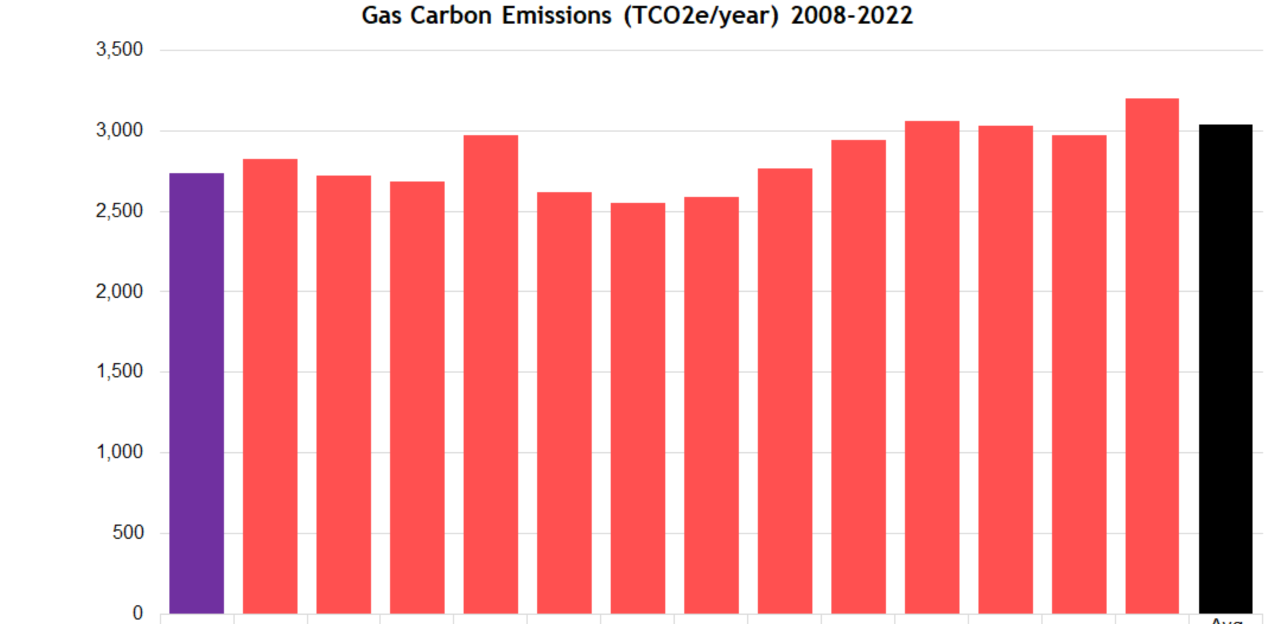


	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Avg 17-22
kWh / year / m2	177	183	176	174	194	170	166	158	149	147	153	151	149	160	152
vs Baseline		3%	-1%	-2%	9%	-4%	-6%	-11%	-16%	-17%	-14%	-15%	-16%	-9%	-14%

Figure 18 – 2008-2022 Gas Consumption Ratio in kWh/year/m2

In relative terms, we used -9% less gas in 2021-22 (at 160 kWh/year/m2) than in 2008-09 (at 177 kWh/year/m2). In average we use 152 kWh of gas/year/m2.

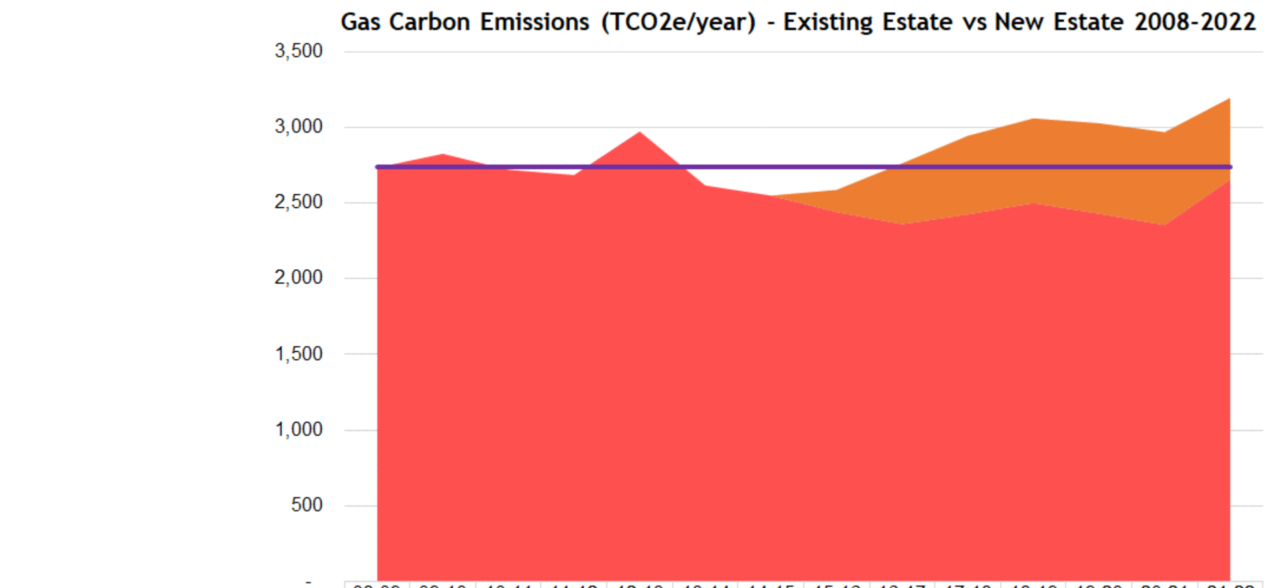
5.2 Gas Carbon emissions analysis



	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Avg 17-22
TCO2e / year	2,736	2,827	2,722	2,687	2,975	2,617	2,551	2,588	2,764	2,946	3,062	3,030	2,970	3,198	3,041
vs Baseline		3%	-1%	-2%	9%	-4%	-7%	-5%	1%	8%	12%	11%	9%	17%	11%

Figure 19 – 2008-2022 Gas Carbon Emissions (TCO2e/year)

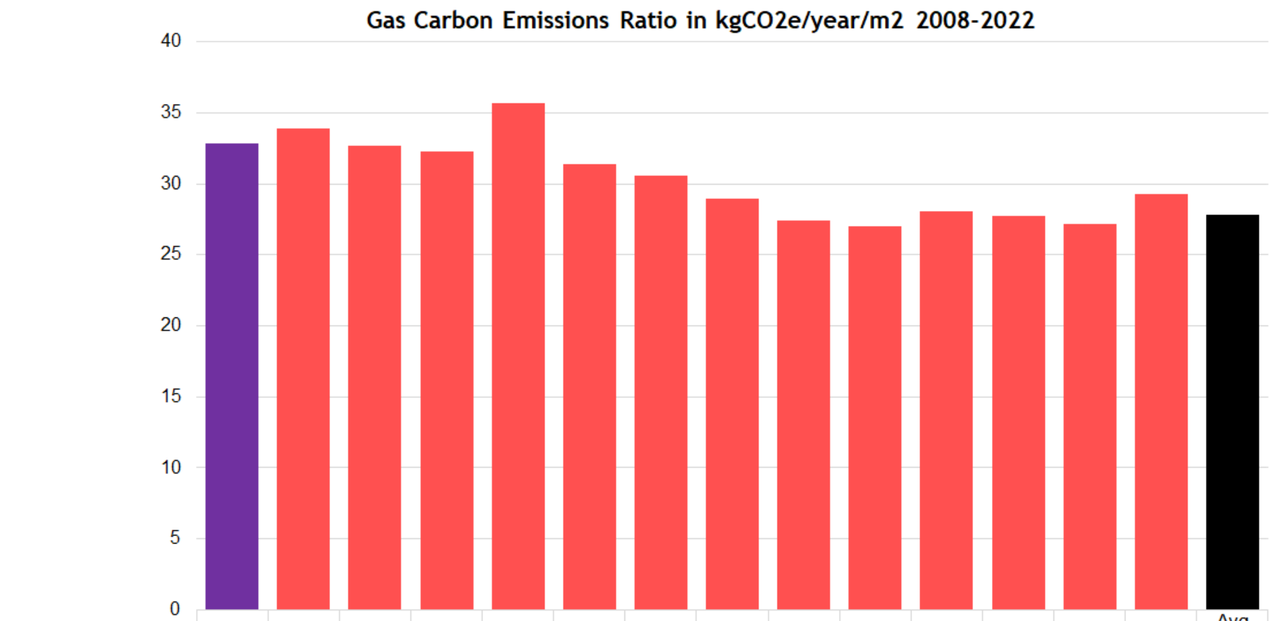
As we have seen, in the period 2008-2022, gas usage has increased by +19% (in absolute terms) and the gas carbon factor (how much carbon emissions is to be associated with the use of 1kWh of gas in the UK) is virtually the same. As a result of these two negatives trends, the company's associated carbon emissions for its use of gas are +17% higher in 21/22 (3198 TCO2e) than in 08/09 (2736 TCO2e), as shown in Figure *19*.



	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22
New Estate (TCO2e/year)	0	0	0	0	0	0	0	146	402	519	560	598	614	540
Existing Estate (TCO2e/year)	2,736	2,827	2,722	2,687	2,975	2,617	2,551	2,442	2,362	2,427	2,501	2,431	2,356	2,658
Baseline (TCO2e/year)	2,736	2,736	2,736	2,736	2,736	2,736	2,736	2,736	2,736	2,736	2,736	2,736	2,736	2,736
vs Baseline (Existing Estate only)		3%	-1%	-2%	9%	-4%	-7%	-11%	-14%	-11%	-9%	-11%	-14%	-3%

Figure 20 - 2008-2022 Gas Carbon Emissions (TCO2e/year) - Existing Estate vs New Estate

Looking at the same size Estates (Existing Estate) carbon emissions associated to gas usage are about -10% lower in recent years (with the exception of 21/22) compared to 2008/09.

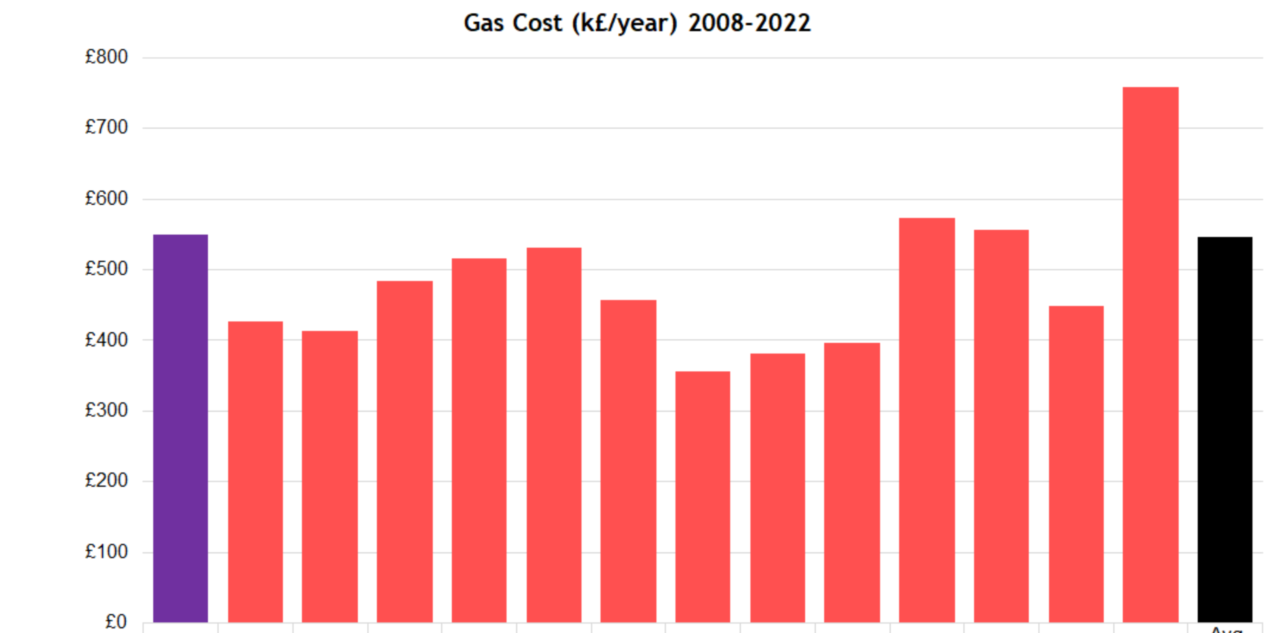


	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Avg 17-22
kgCO2e / year / m2	33	34	33	32	36	31	31	29	27	27	28	28	27	29	28
vs Baseline		3%	-1%	-2%	9%	-4%	-7%	-12%	-17%	-18%	-15%	-15%	-17%	-11%	-15%

Figure 21 – 2008-2022 Gas Carbon Emissions Ratio in kgCO2e/year/m2

In relative terms, we emitted -11% less carbon emissions associated to our use of gas in 21-22 (at 29 kgCO2e/year/m2) vs 08-09 baseline (at 33 kgCO2e/year/m2).

5.3 Gas Costs analysis



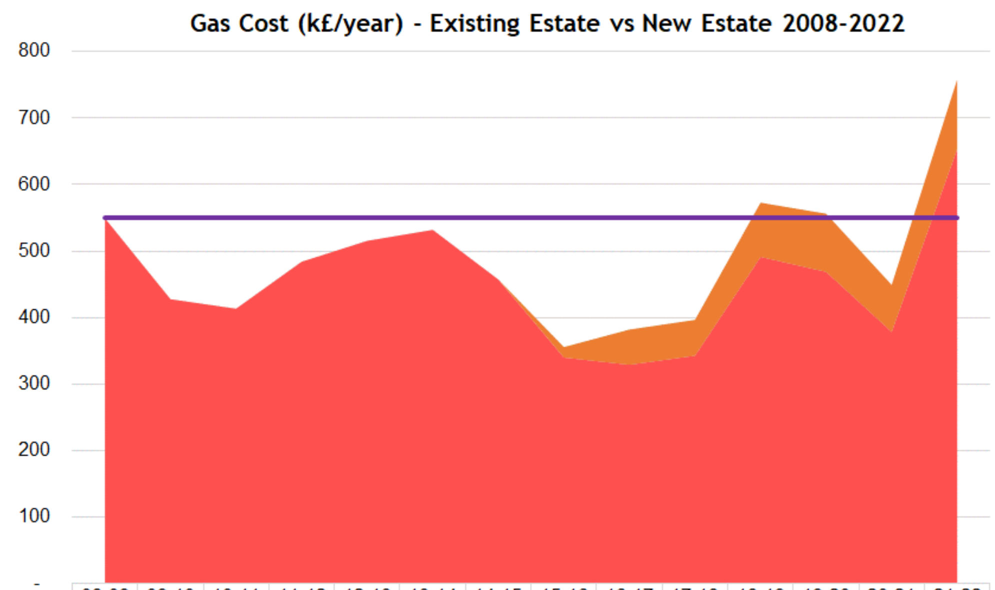
	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Avg 17-22
k£ / year	£549	£428	£413	£484	£516	£532	£457	£356	£382	£397	£573	£556	£449	£758	£547
vs Baseline		-22%	-25%	-12%	-6%	-3%	-17%	-35%	-30%	-28%	4%	1%	-18%	38%	0%

Figure 22 - 2008-2022 Gas Cost (k£/year)

At its lowest points (2015 to 2018), gas expenditure was only around £375k p.a. As explained at the beginning of this report in “2.5 *How we purchased energy and its impacts*” the wholesale gas markets were unusually low and thanks to our flexible energy purchasing strategy we saved in total over this period well over £500k vs a fixed contract (the equivalent of 1 year of gas expenditure at UoR). This is clearly visible in Figure *22*.

We can also see how we have started to be impacted by the energy crisis: the gas expenditure in FY21-22 was £758k (+£227k or +38%) due to additional group gas volumes requirements at inflated markets times.

Despite c. +10% increase in gas usage in the last couple of years (Figure *16*) owing to the increase in the size of the Estates (Figure *17*), thanks to the energy purchasing strategy, average gas expenditure in the last 5 years is (at £574k p.a) similar to 2008-09 !

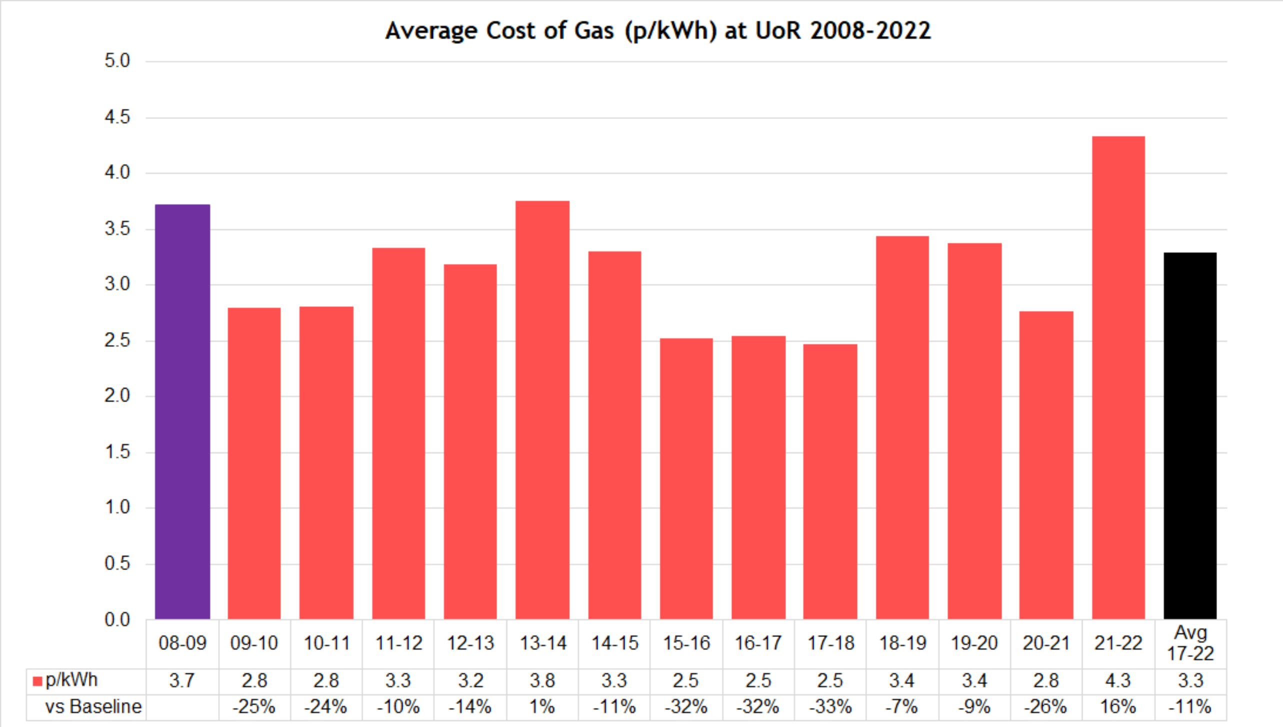


	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22
New Estate (k£/year)	-	-	-	-	-	-	-	16	53	54	81	87	70	104
Existing Estate (k£/year)	549	428	413	484	516	532	457	340	329	343	491	469	379	654
Baseline (k£/year)	549	549	549	549	549	549	549	549	549	549	549	549	549	549
vs Baseline (Existing Estate only)		-22%	-25%	-12%	-6%	-3%	-17%	-38%	-40%	-38%	-11%	-15%	-31%	19%

Figure 23 - 2008-2022 Gas Cost (k£/year) - Existing Estate vs New Estate

As we can see above in Figure *23* should we have the same Estates size, in the period FY15-21, gas expenditure was in average -29% lower than in 2008-09.

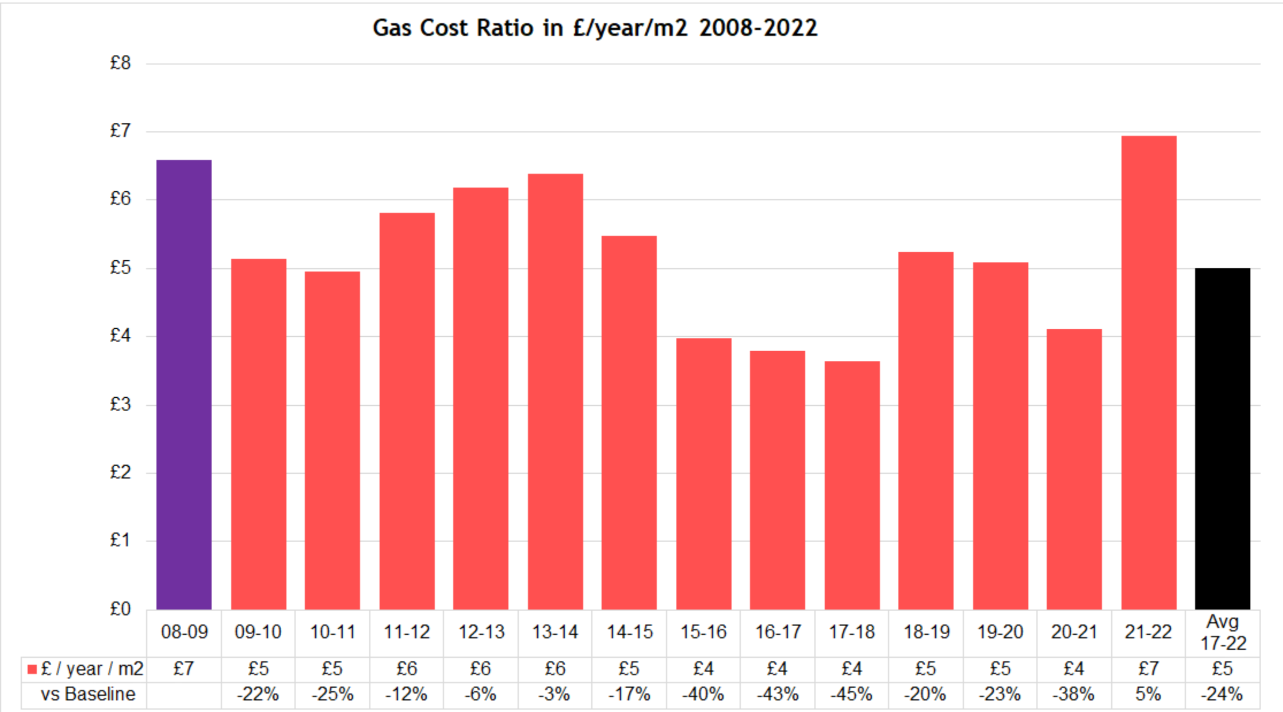
Once again this is certainly a valuable achievement, from a cost management perspective, of the advantages of the flexible energy purchasing strategy we put in place in 2014 which allowed us to grasp the benefits of unusually wholesale gas markets in the period 2014-2018. This would not have been possible for that length of time and at these levels on fixed contracts.



	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Avg 17-22
p/kWh	3.7	2.8	2.8	3.3	3.2	3.8	3.3	2.5	2.5	2.5	3.4	3.4	2.8	4.3	3.3
vs Baseline		-25%	-24%	-10%	-14%	1%	-11%	-32%	-32%	-33%	-7%	-9%	-26%	16%	-11%

Figure 24 - 2008-2022 Average Cost of Gas at UoR (p/kWh)

The average cost of gas at UoR was 2.5p/kWh at its lowest point (FY15-18) and is now 4.3p/kWh, a +16% increase on the 3.7p/kWh we were paying 14 years ago.



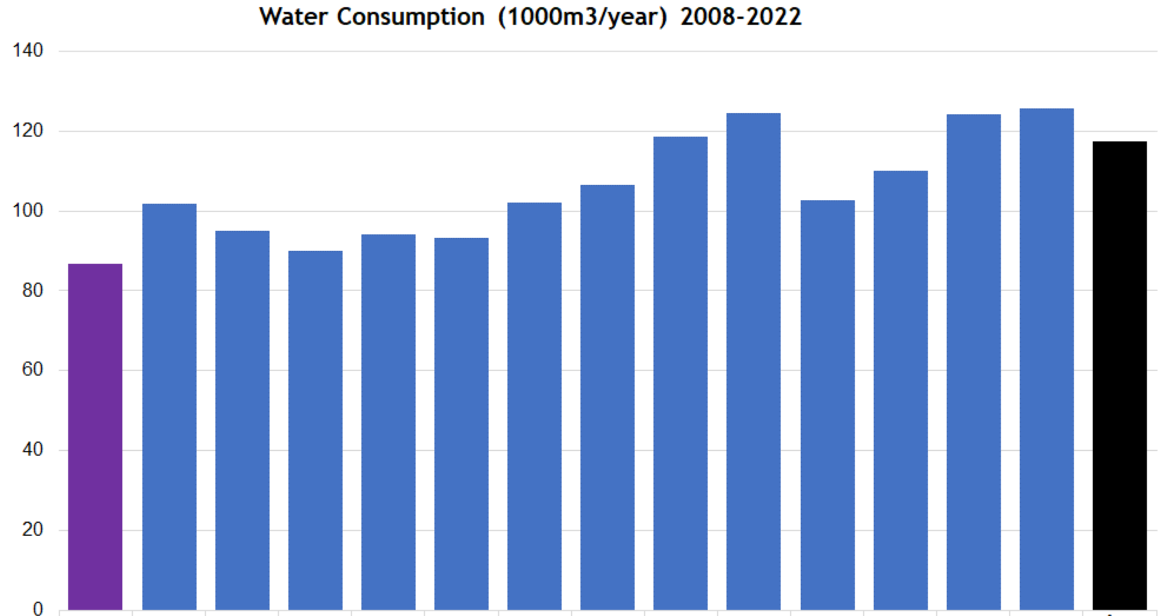
	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Avg 17-22
£ / year / m2	£7	£5	£5	£6	£6	£6	£5	£4	£4	£4	£5	£5	£4	£7	£5
vs Baseline		-22%	-25%	-12%	-6%	-3%	-17%	-40%	-43%	-45%	-20%	-23%	-38%	5%	-24%

Figure 25 - 2008-2022 Gas Cost Ratio in £/year/m2

In average, each m2 of building cost us £5/year in gas.

6. WATER

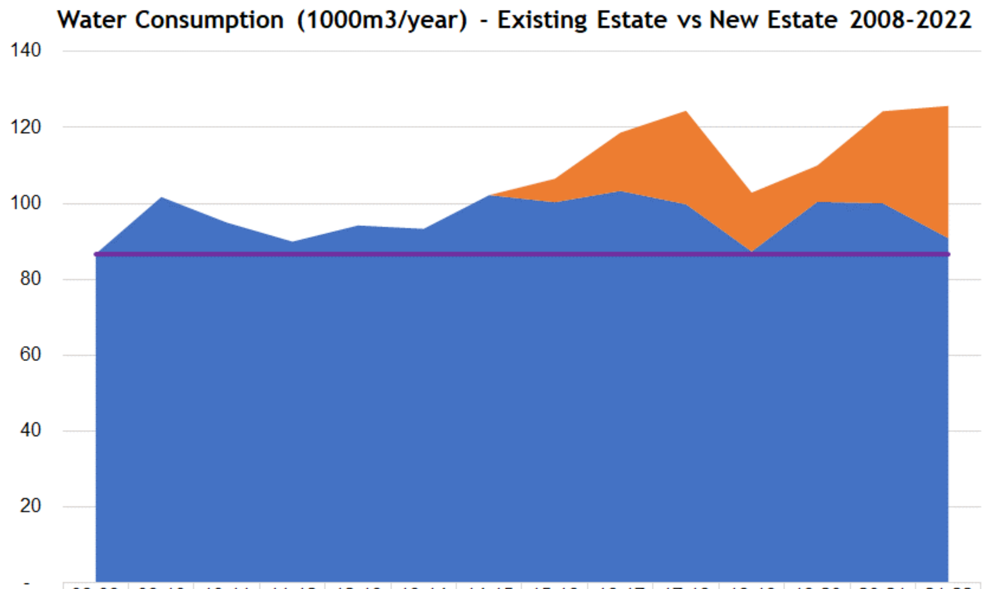
6.1 Water Consumption analysis



	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Avg 17-22
1000m3 / year	87	102	95	90	94	93	102	106	119	124	103	110	124	126	117
vs Baseline		17%	10%	4%	9%	8%	18%	23%	37%	44%	19%	27%	43%	45%	35%

Figure 26 – 2008-2022 Water Consumption (1000m3/year)

As we can see in Figure *26*, in average over the last 5 years (2017-22) annual water consumption was +35% higher (at 117,000m3/year) than in our baseline year 2008/09 (at 87,000m3/year).



	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22
New Estate (1000m3/year)	-	-	-	-	-	-	-	6	15	25	15	10	24	35
Existing Estate (1000m3/year)	87	102	95	90	94	93	102	100	103	100	87	100	100	91
Baseline (1000m3/year)	87	87	87	87	87	87	87	87	87	87	87	87	87	87
vs Baseline (Existing Estate only)		17%	10%	4%	9%	8%	18%	16%	19%	15%	1%	16%	15%	5%

Figure 27 – 2008-2022 Water Consumption (1000m3/year) – Existing Estate vs New Estate

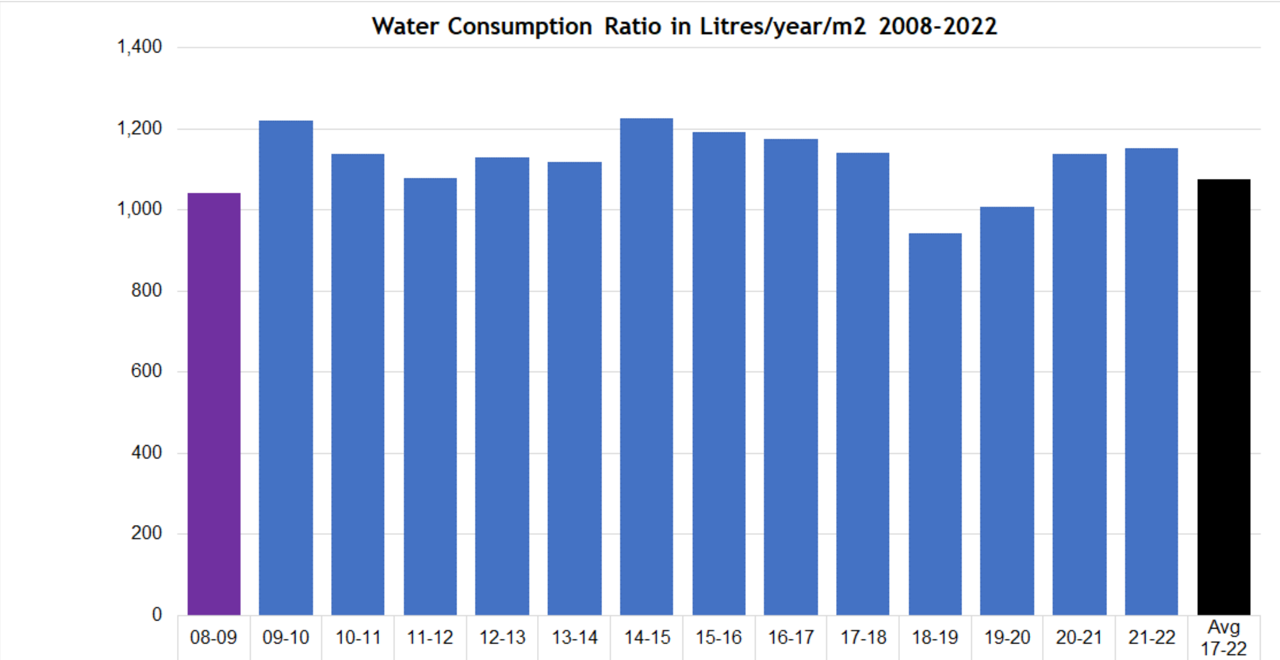
The overall trend in increased water consumption is not only due to the increased Estates size: the Existing Estates water consumption is about +15% higher than in 2008-09.

This could be explained by perhaps an increase in students/staff numbers or behaviour, undetected water leaks and water wastage (toilets cisterns or urinals constantly flushing, taps hard to close), the increased weekly ‘flushing requirements’ during low buildings occupation in the 2 years COVID period to comply with Legionella prevention, etc.

Owing to very limited human resources, technical challenges (e.g. water efficient shower heads tend to not withstand frequent cleaning regimes) and long ROI, investments in water efficient products replacements have also been remotely inexistent (some waterless urinals trialled but not satisfactory).

We have however dealt with the detection and repair of several large water leaks over the years, some of which are recorded in “*11.Utilities Savings and Management: Completed Projects 2010 – 2022*”.

Since January 2019 we finally have Automatic Meter Reading on all water fiscal meters, which collects water consumption data every half hour. This is used for billing but the system is also set to raise automatic ‘high water consumption alerts’ sent by our current water retailer to the University for further investigations and action.

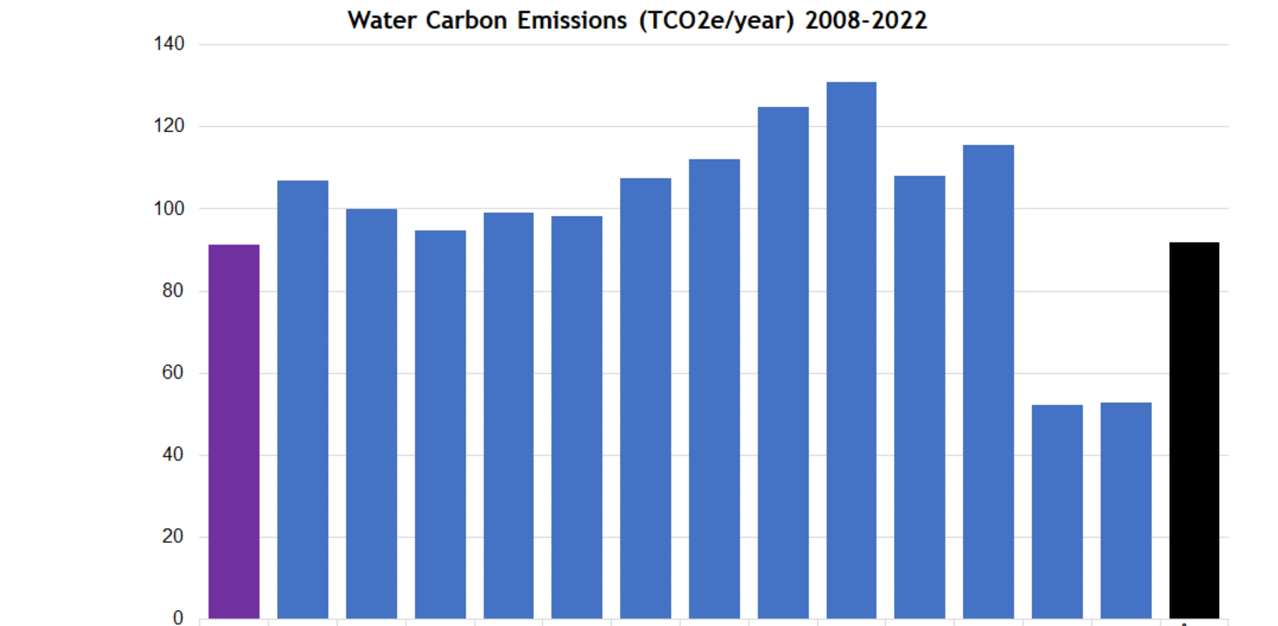


	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Avg 17-22
Litres / year / m2	1,040	1,220	1,139	1,079	1,130	1,120	1,225	1,192	1,176	1,140	942	1,007	1,138	1,152	1,076
vs Baseline		17%	10%	4%	9%	8%	18%	15%	13%	10%	-9%	-3%	9%	11%	3%

Figure 28 - 2008-2022 Water Consumption Ratio in kWh/year/m2

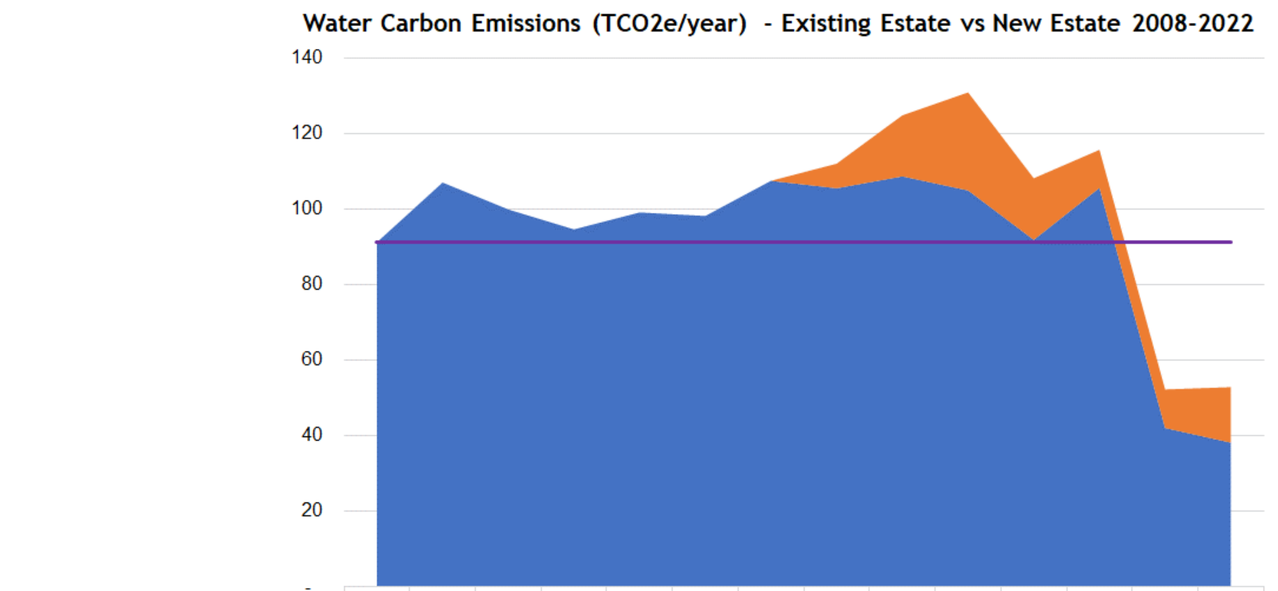
In average (2017-22) we use 1,076 litres of water/year/m2.

6.2 Water Carbon emissions analysis



	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Avg 17-22
TCO2e / year	91	107	100	95	99	98	107	112	125	131	108	116	52	53	92
vs Baseline		17%	10%	4%	9%	8%	18%	23%	37%	43%	19%	27%	-43%	-42%	1%

Figure 29 – 2008-2022 Water Carbon Emissions (TCO2e/year)



	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22
New Estate (TCO2e/year)	-	-	-	-	-	-	-	6	16	26	16	10	10	15
Existing Estate (TCO2e/year)	91	107	100	95	99	98	107	106	109	105	92	106	42	38
Baseline (TCO2e/year)	91	91	91	91	91	91	91	91	91	91	91	91	91	91
vs Baseline (Existing Estate only)		17%	10%	4%	9%	8%	18%	16%	19%	15%	1%	16%	-54%	-58%

Figure 30 – 2008-2022 Water Carbon Emissions (TCO2e/year) – Existing Estate vs New Estate

As we can see in Figure *29* and *Figure 30* carbon emissions related to our usage of mains water and wastewater treatment is currently -42% lower (current Estates) and -58% lower (existing Estates), despite the overall trend in water consumption increase, since 2008-09.

As explained in "3.2.6 Utilities Carbon Factors" this is because the methodology used by BEIS to derive the water and wastewater carbon factors used data from 2012 until updated in 2021 and now takes into account the decarbonisation of the UK grid electricity, which is used for water supply and treatment.

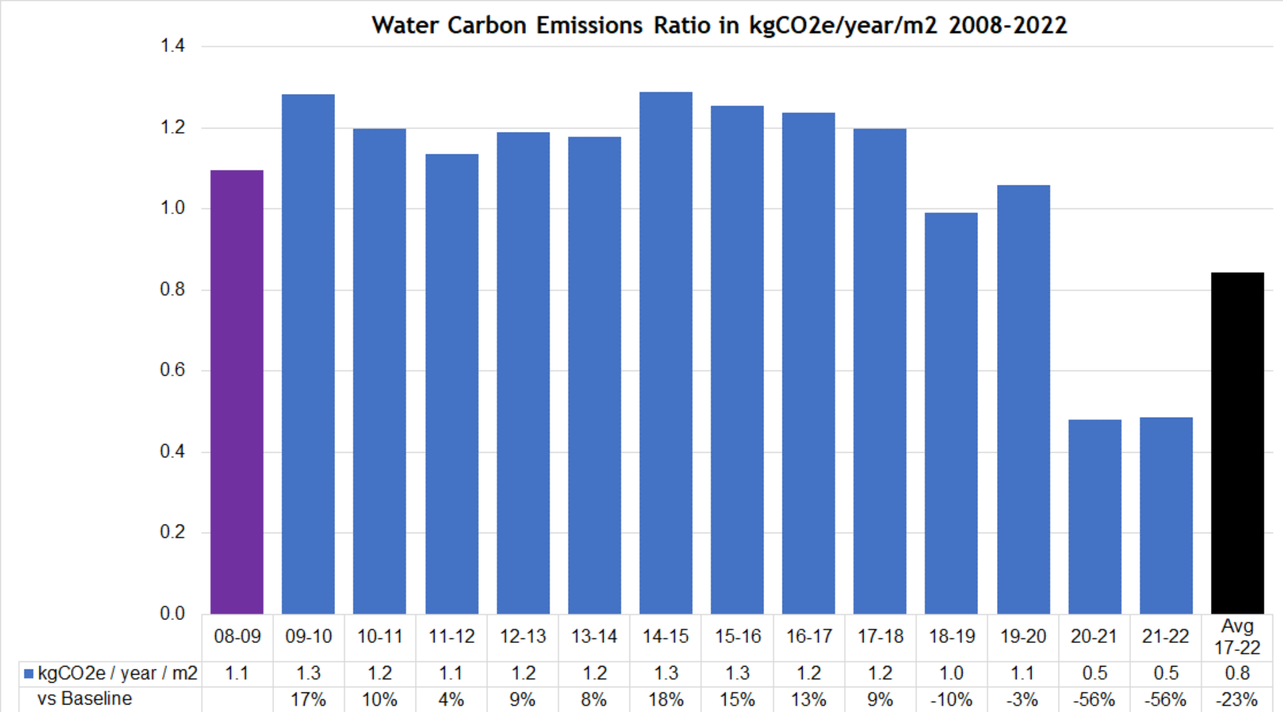
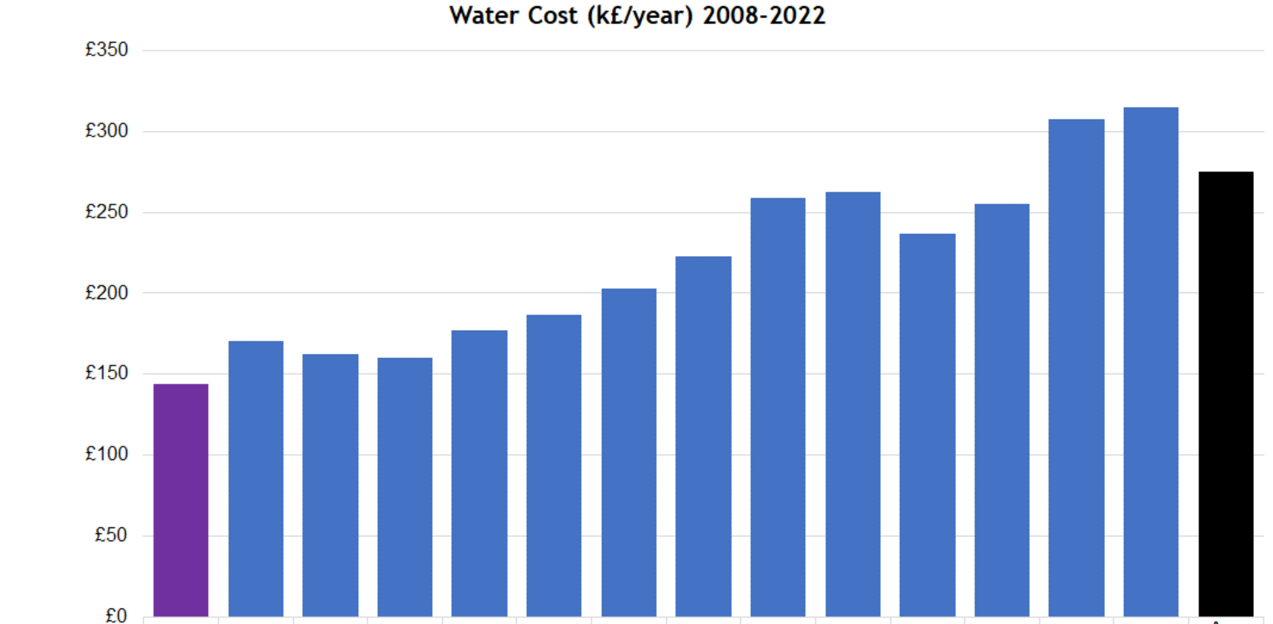


Figure 31 - 2008-2022 Water Carbon Emissions Ratio in kgCO2e/year/m2

In relative terms, we emit 0.5 kgCO2e/year/m2 associated to our use of mains water and wastewater treatment.

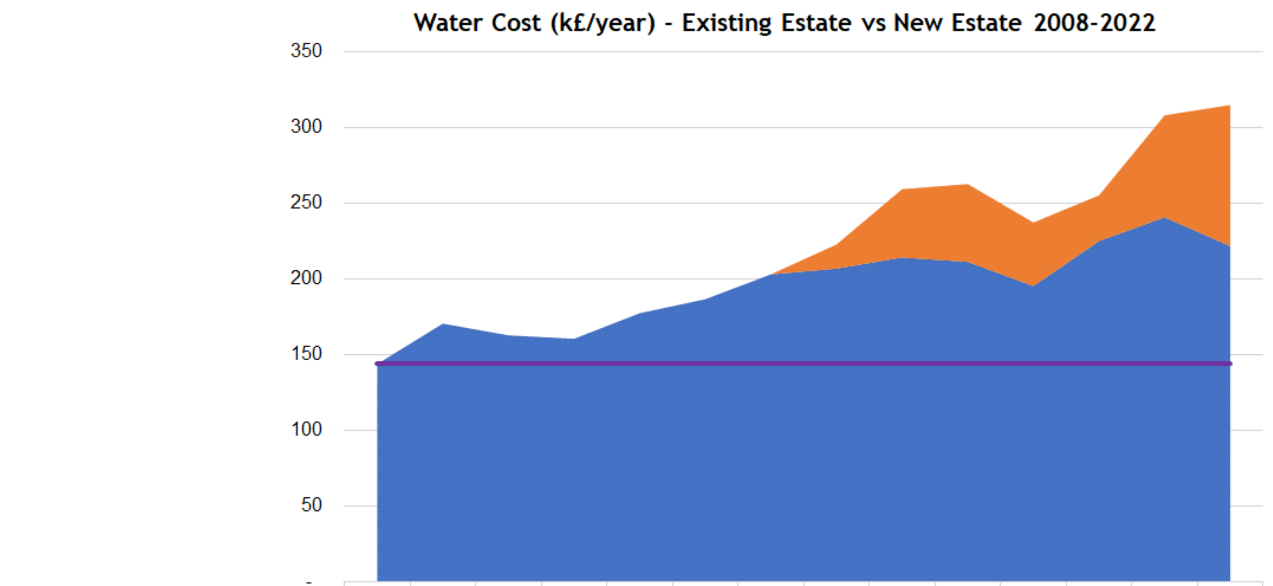
6.3 Water Costs analysis



	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Avg 17-22
k£ / year	£144	£171	£163	£161	£177	£187	£203	£223	£259	£263	£237	£255	£308	£315	£275
vs Baseline		19%	13%	12%	23%	30%	41%	55%	80%	82%	65%	77%	114%	119%	91%

Figure 32 - 2008-2022 Water Cost (k£/year)

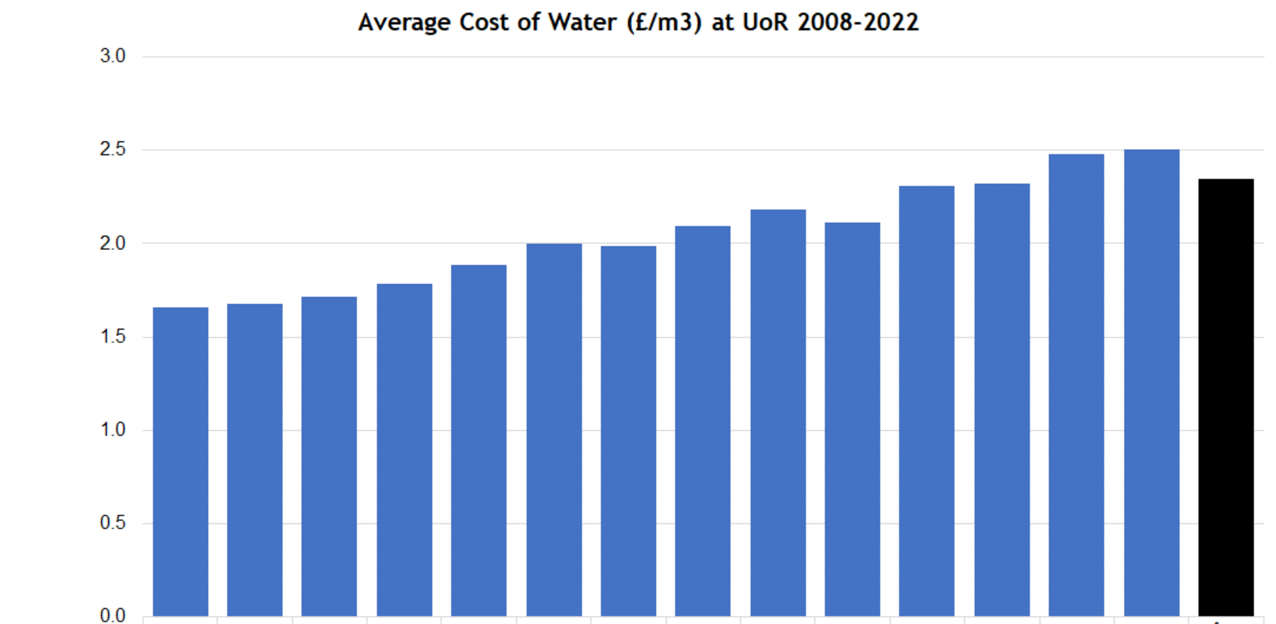
As we have seen in Figure *26*, in average (2017-22) water consumption is +35% higher and water units costs have increased by +51% (Figure *34*). The combination of these two negatives trends means our water expenditure currently is £315k/year and in average 91% higher than 2008-09.



	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22
New Estate (k£/year)	0	0	0	0	0	0	0	16	45	51	42	30	67	93
Existing Estate (k£/year)	144	171	163	161	177	187	203	207	214	211	195	225	241	222
Baseline (k£/year)	144	144	144	144	144	144	144	144	144	144	144	144	144	144
vs Baseline (Existing Estate only)		19%	13%	12%	23%	30%	41%	44%	49%	47%	36%	56%	67%	54%

Figure 33 - 2008-2022 Water Cost (k£/year) – Existing Estate vs New Estate

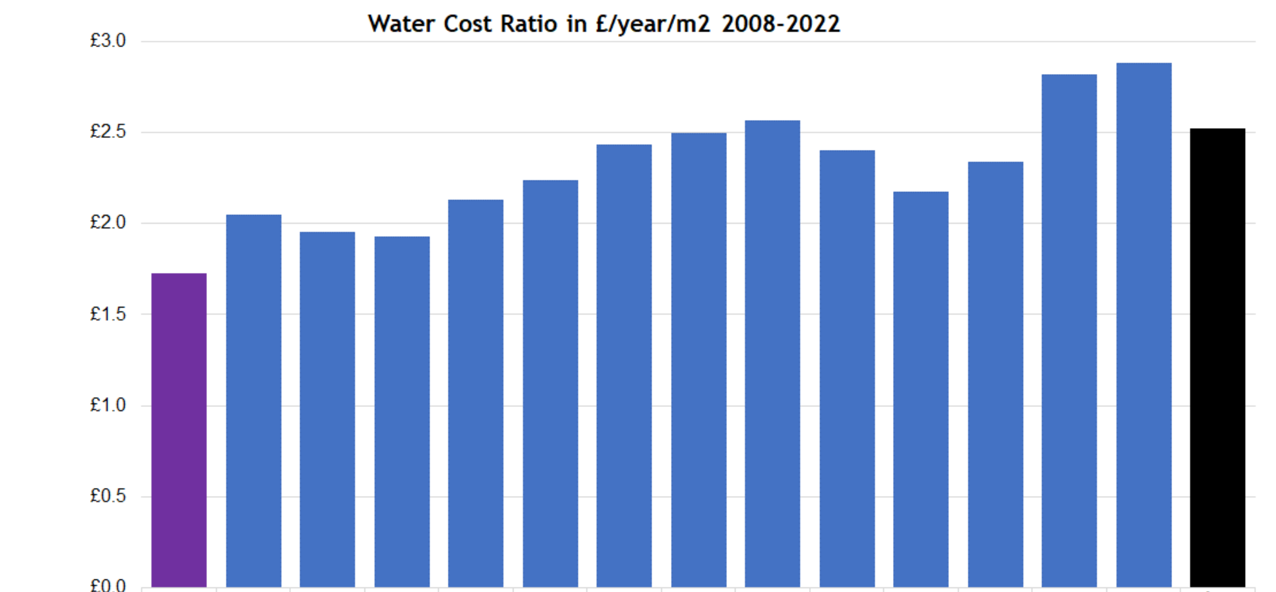
Even at 'same Estates size' our water expenditure is 54% higher than 14 years ago.



	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Avg 17-22
£/m3	1.7	1.7	1.7	1.8	1.9	2.0	2.0	2.1	2.2	2.1	2.3	2.3	2.5	2.5	2.3
vs Baseline		1%	3%	8%	13%	20%	20%	26%	32%	27%	39%	40%	49%	51%	41%

Figure 34 - 2008-2022 Average Cost of Water at UoR (£/m3)

The average cost of water at UoR has increased steadily over the years: it is now 2.5 £/m3, a +51% increase on the 1.7£/m3 we were paying 14 years ago.



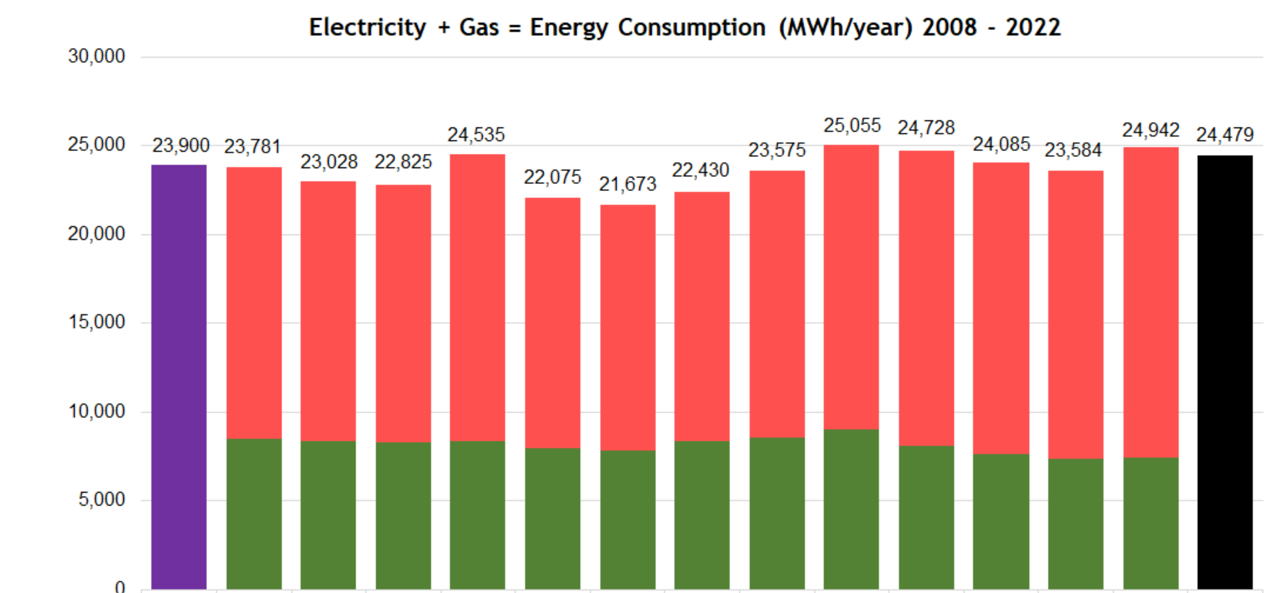
	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Avg 17-22
£ / year / m2	£1.7	£2.0	£2.0	£1.9	£2.1	£2.2	£2.4	£2.5	£2.6	£2.4	£2.2	£2.3	£2.8	£2.9	£2.5
Baseline	£1.7	£1.7	£1.7	£1.7	£1.7	£1.7	£1.7	£1.7	£1.7	£1.7	£1.7	£1.7	£1.7	£1.7	£1.7
vs Baseline		19%	13%	12%	23%	30%	41%	44%	49%	39%	26%	35%	63%	67%	46%

Figure 35 - 2008-2022 Water Cost Ratio in £/year/m2

Each m2 of building cost us £2.9/year in water.

7. ALL UTILITIES

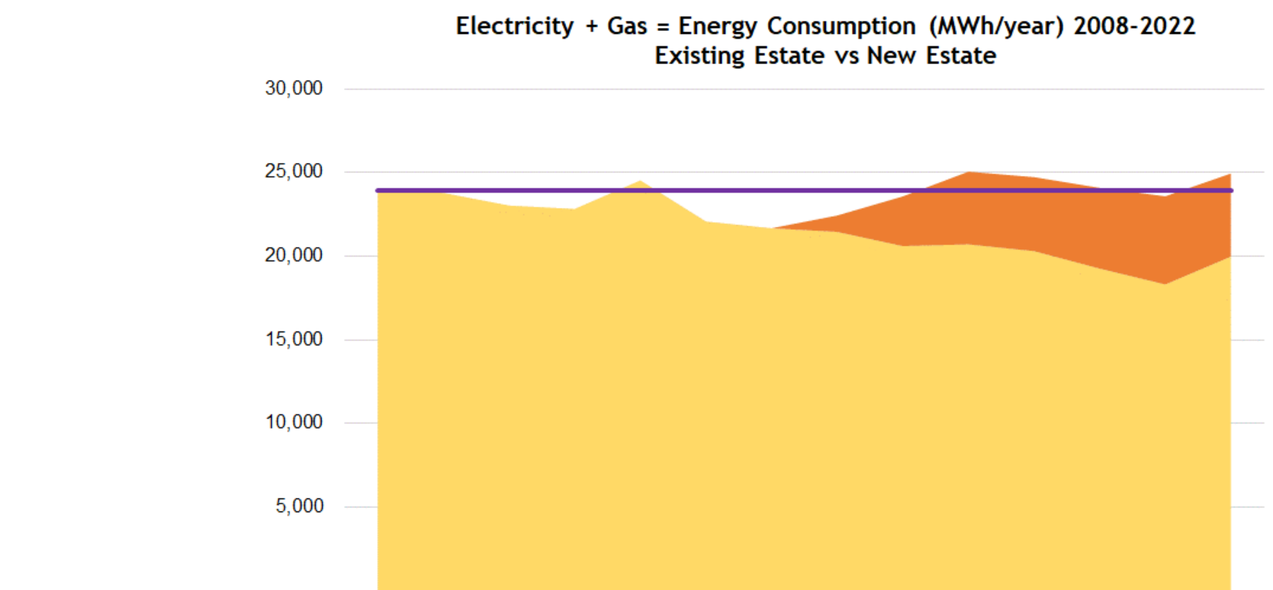
7.1 Electricity + Gas = Energy Consumption analysis



	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Avg 17-22
MWh / year	14,773	15,264	14,694	14,506	16,163	14,150	13,830	14,067	15,009	16,016	16,653	16,477	16,218	17,517	16,576
MWh / year	9,127	8,517	8,333	8,319	8,371	7,925	7,843	8,363	8,566	9,039	8,075	7,608	7,366	7,426	7,903
vs Baseline		0%	-4%	-4%	3%	-8%	-9%	-6%	-1%	5%	3%	1%	-1%	4%	2%

Figure 36 – 2008-2022 Energy Consumption (MWh/year)

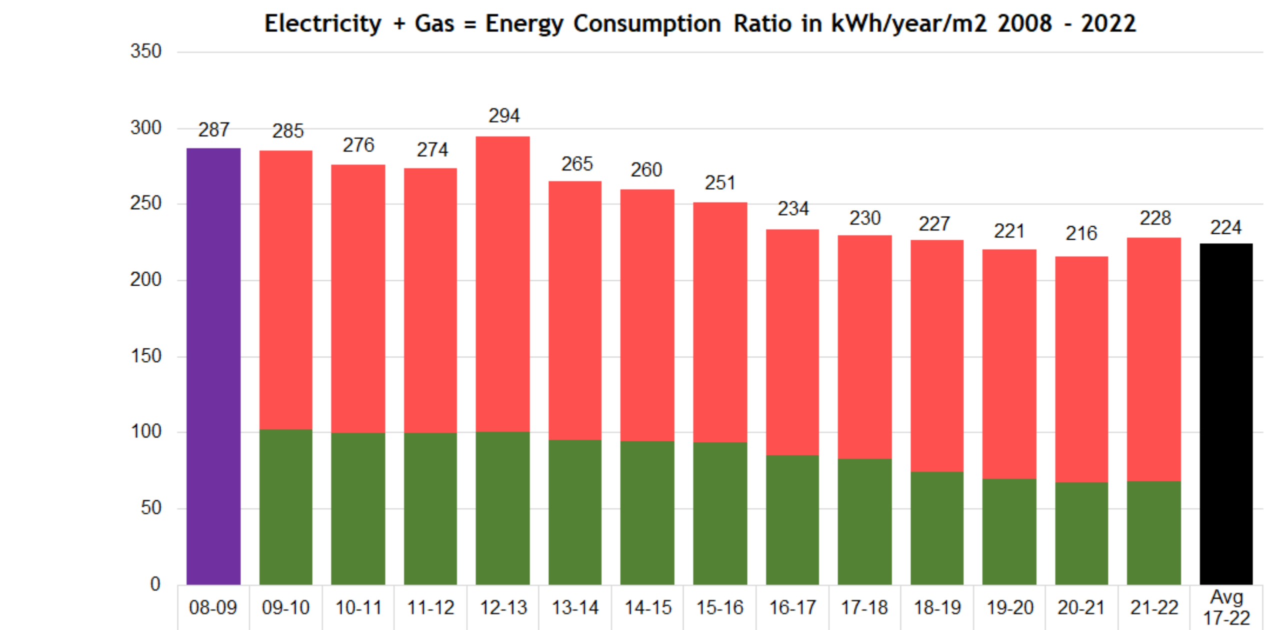
Average energy usage is 24,479 MWh/year.



	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22
New Estate (MWh/year)	-	-	-	-	-	-	-	972	2,963	4,344	4,420	4,817	5,265	4,959
Existing Estate (MWh/year)	23,900	23,781	23,028	22,825	24,535	22,075	21,673	21,458	20,612	20,711	20,309	19,267	18,318	19,983
Baseline (MWh/year)	23,900	23,900	23,900	23,900	23,900	23,900	23,900	23,900	23,900	23,900	23,900	23,900	23,900	23,900
vs Baseline (Existing Estate only)		0%	-4%	-4%	3%	-8%	-9%	-10%	-14%	-13%	-15%	-19%	-23%	-16%

Figure 37 - 2008-2022 Energy Consumption (MWh/year) – Existing Estate vs New Estate

Energy usage is slightly higher (+4% in 21/22, +2% in average) vs 08/09 (Figure *36*) because of the new builds (Figure *37*). At same Estates size, overall energy usage has reduced by -16%.

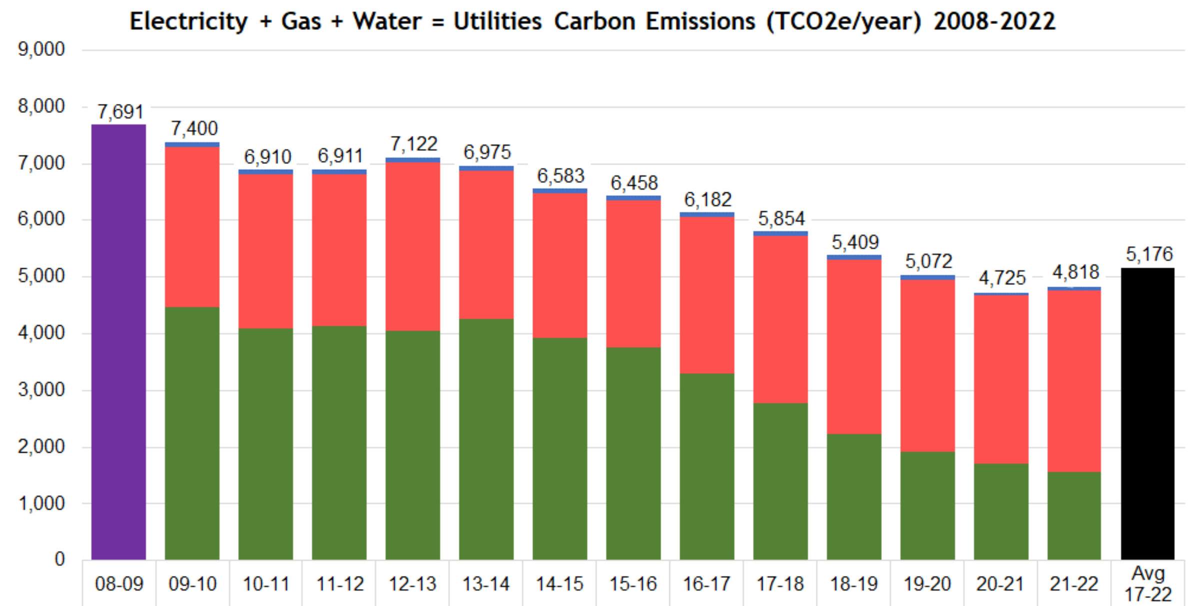


	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Avg 17-22
■ kWh / year / m2 (red)	177	183	176	174	194	170	166	158	149	147	153	151	149	160	152
■ kWh / year / m2 (green)	110	102	100	100	100	95	94	94	85	83	74	70	67	68	72
vs Baseline		0%	-4%	-4%	3%	-8%	-9%	-12%	-19%	-20%	-21%	-23%	-25%	-20%	-22%

Figure 38 – 2008-2022 Energy Consumption Ratio in kWh/year/m2

In average we use 224 kWh of energy/year/m2.

7.2 Electricity + Gas + Water = Utilities Carbon Emissions analysis



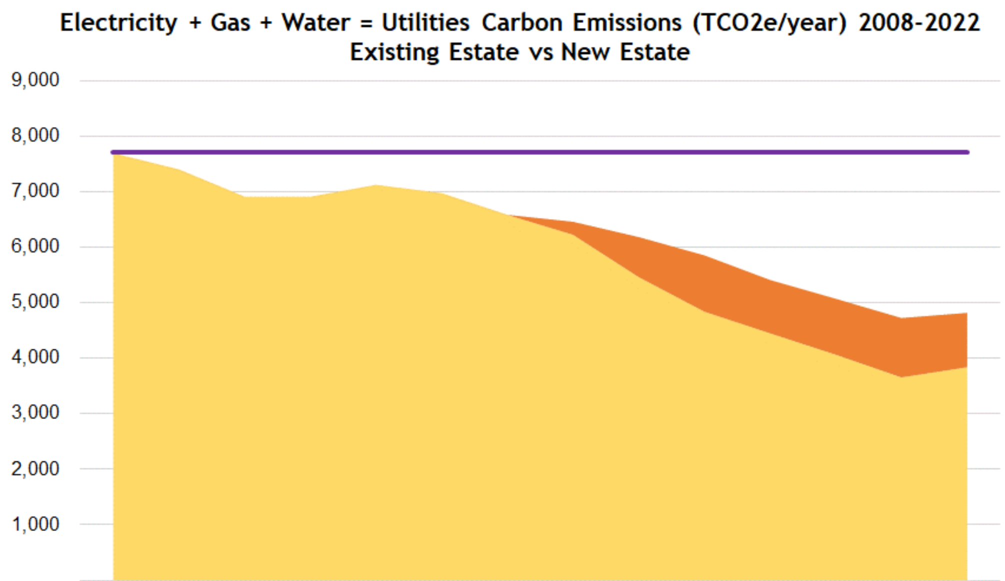
	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Avg 17-22
TCO2e / year	91	107	100	95	99	98	107	112	125	131	108	116	52	53	92
TCO2e / year	2,736	2,827	2,722	2,687	2,975	2,617	2,551	2,588	2,764	2,946	3,062	3,030	2,970	3,198	3,041
TCO2e / year	4,864	4,466	4,089	4,129	4,048	4,259	3,924	3,758	3,293	2,777	2,239	1,926	1,702	1,567	2,042
vs Baseline		-4%	-10%	-10%	-7%	-9%	-14%	-16%	-20%	-24%	-30%	-34%	-39%	-37%	-33%

Figure 39 – 2008-2022 Utilities Carbon Emissions (TCO2e/year)

In absolute terms, i.e. despite the increase in the Estates size, **we have reduced carbon emissions related to our usage of utilities by -39% !**

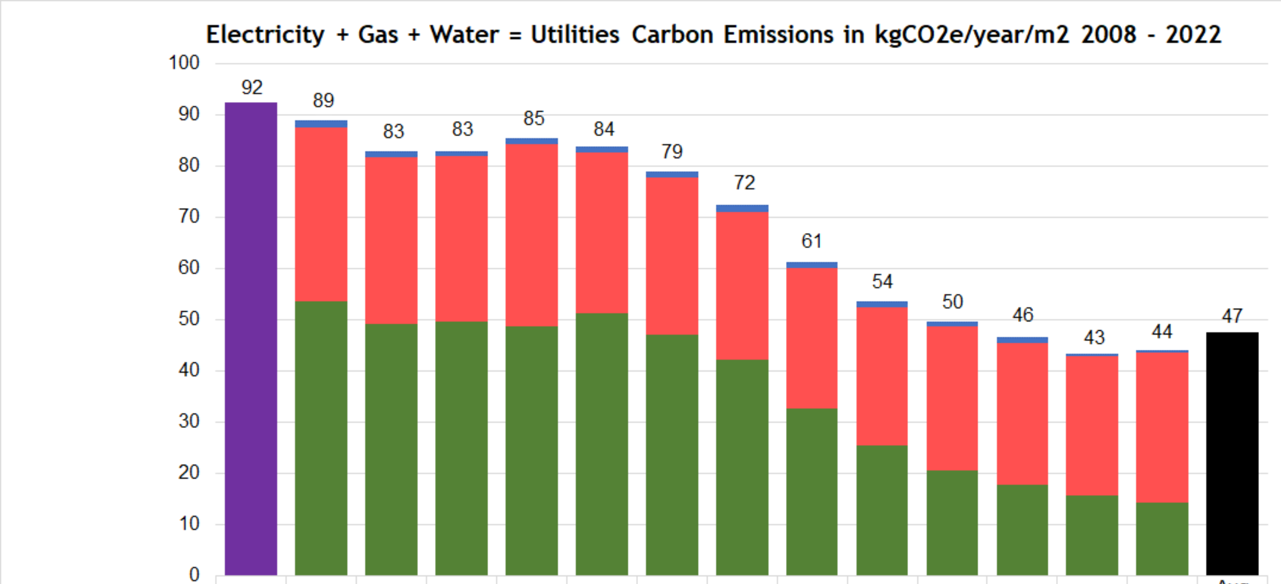
This **very significant achievement** at organisation level with **only 1 member of staff** is mainly thanks to our continuous and successful efforts to save electricity, helped by the decarbonisation of the UK Grid Electricity.

Our Utilities Carbon emissions are 4725 TCO2/year in 20-21.



	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22
New Estate (TCO2e/year)	-	-	-	-	-	-	-	233	718	1,013	957	1,004	1,066	977
Existing Estate (TCO2e/year)	7,691	7,400	6,910	6,911	7,122	6,975	6,583	6,225	5,464	4,841	4,452	4,067	3,659	3,841
Baseline (TCO2e/year)	7,698	7,698	7,698	7,698	7,698	7,698	7,698	7,698	7,698	7,698	7,698	7,698	7,698	7,698
vs Baseline (Existing Estate only)		-4%	-10%	-10%	-7%	-9%	-14%	-19%	-29%	-37%	-42%	-47%	-52%	-50%

Figure 40 - 2008-2022 Utilities Carbon Emissions (TCO2e/year) – Existing Estate vs New Estate

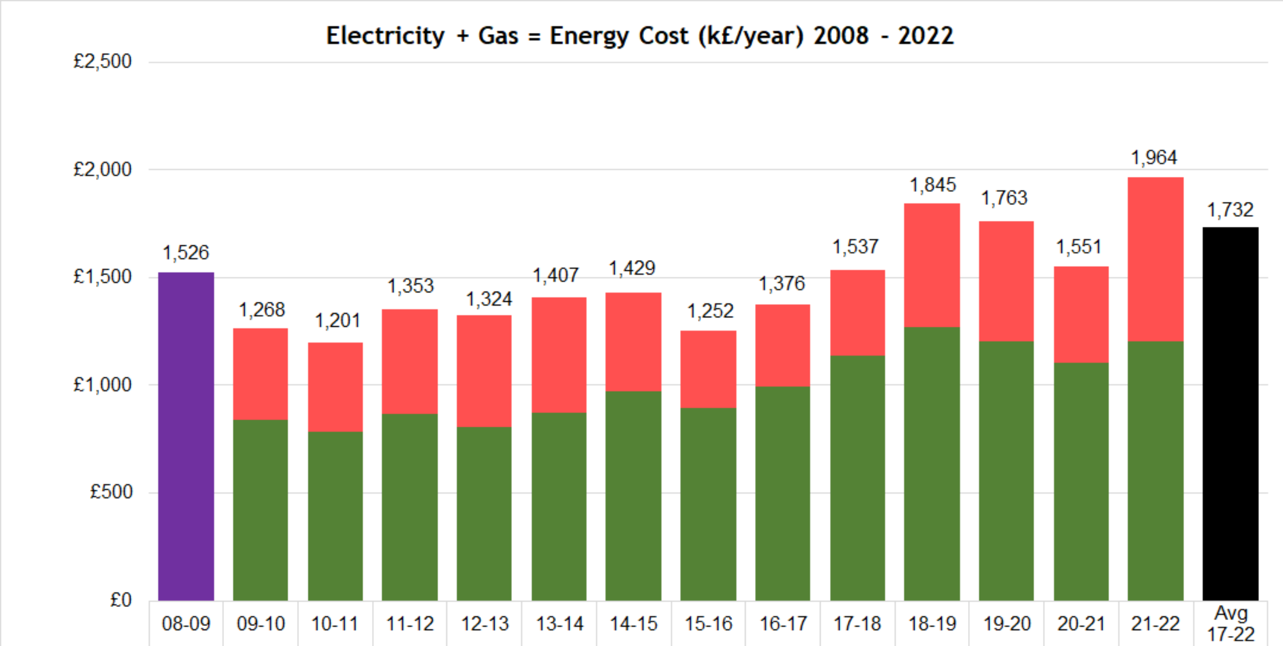


	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Avg 17-22
■ kgCO2e / year / m2 (blue)	1.1	1.3	1.2	1.1	1.2	1.2	1.3	1.3	1.2	1.2	1.0	1.1	0.5	0.5	0.8
■ kgCO2e / year / m2 (red)	33	34	33	32	36	31	31	29	27	27	28	28	27	29	28
■ kgCO2e / year / m2 (green)	58	54	49	50	49	51	47	42	33	25	21	18	16	14	19
vs Baseline		-4%	-10%	-10%	-7%	-9%	-14%	-22%	-34%	-42%	-46%	-50%	-53%	-52%	-49%

Figure 41 - 2008-2022 Utilities Carbon Emissions in kgCO2e/year/m2

In relative terms (kgCO2e/year/m2) and at same Estates size, carbon emissions are in average (2017-22) -49% and -50% lower than in our 2008-09 baseline year.

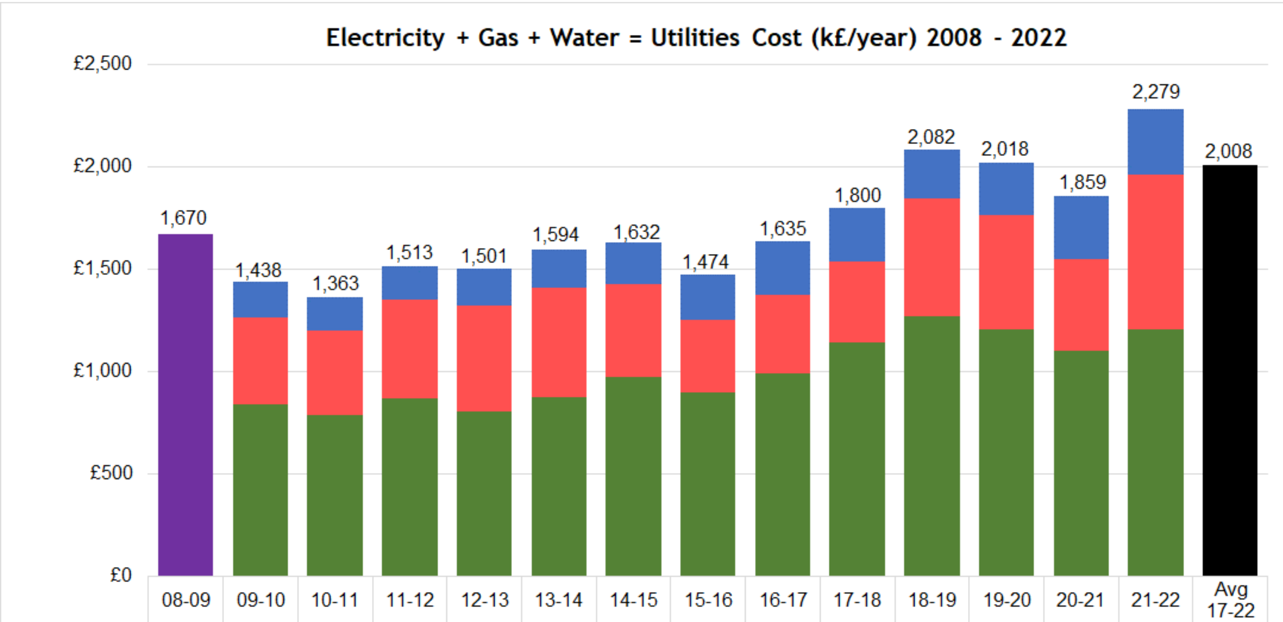
7.3 Electricity + Gas + Water = Utilities Costs analysis



	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Avg 17-22
k£ / year	£549	£428	£413	£484	£516	£532	£457	£356	£382	£397	£573	£556	£449	£758	£547
k£ / year	£977	£840	£787	£869	£808	£876	£972	£896	£994	£1,141	£1,272	£1,207	£1,102	£1,206	£1,186
vs Baseline		-17%	-21%	-11%	-13%	-8%	-6%	-18%	-10%	1%	21%	15%	2%	29%	13%

Figure 42 – 2008-2022 Energy Cost (k£/year)

Our energy expenditure which has been for the last 14 years in the range £1.2M - £1.8M p.a., (elec £1.2M; gas £0.6M) was just under £2M last year.



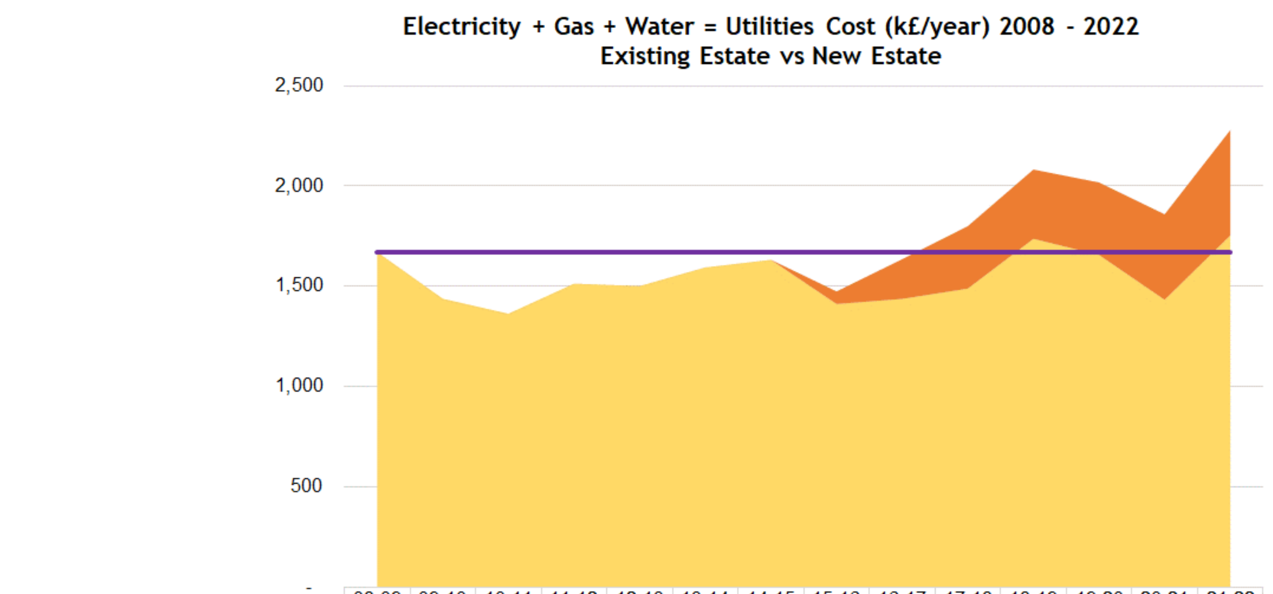
	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Avg 17-22
k£ / year	£144	£171	£163	£161	£177	£187	£203	£223	£259	£263	£237	£255	£308	£315	£275
k£ / year	£549	£428	£413	£484	£516	£532	£457	£356	£382	£397	£573	£556	£449	£758	£547
k£ / year	£977	£840	£787	£869	£808	£876	£972	£896	£994	£1,141	£1,272	£1,207	£1,102	£1,206	£1,186
vs Baseline		-14%	-18%	-9%	-10%	-5%	-2%	-12%	-2%	8%	25%	21%	11%	36%	20%

Figure 43 – 2008-2022 Utilities Cost (k£/year)

Overall utilities expenditure has increased in average by 20% compared to 2008-09.

Utilities Expenditure was nearly £2.3M last year.

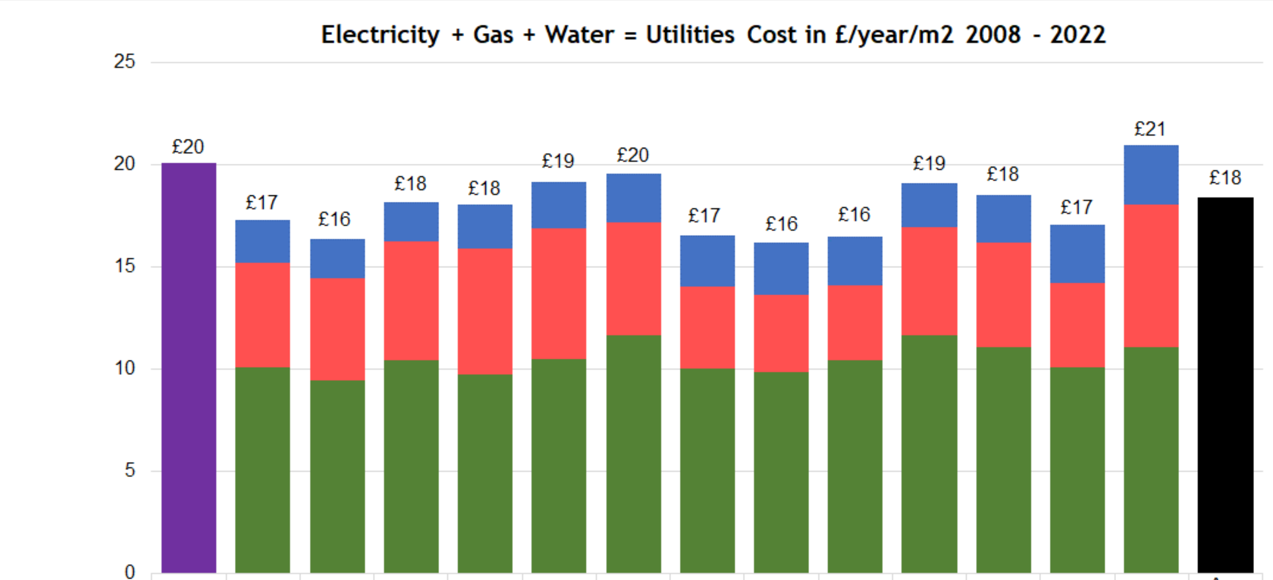
As presented in "*11. Utilities Savings and Management: Completed Projects 2010 - 2022*" **without active energy management and 'invest to save' projects, energy expenditure would be at least £530k higher at £2.6M today** (without the current energy price crisis).



	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22
New Estate (k£/year)	-	-	-	-	-	-	-	62	197	311	345	361	426	525
Existing Estate (k£/year)	1,670	1,438	1,363	1,513	1,501	1,594	1,632	1,412	1,438	1,489	1,738	1,657	1,433	1,754
Baseline (k£/year)	1,670	1,670	1,670	1,670	1,670	1,670	1,670	1,670	1,670	1,670	1,670	1,670	1,670	1,670
vs Baseline (Existing Estate only)		-14%	-18%	-9%	-10%	-5%	-2%	-15%	-14%	-11%	4%	-1%	-14%	5%

Figure 44 – 2008-2022 Utilities Cost (k£/year) - Existing Estate vs New Estate

Thanks to our usage reduction efforts, at same Estates size (existing Estates) our Utilities expenditure is about the same than 14 years ago!



	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Avg 17-22
£ / year / m2	£1.7	£2.0	£2.0	£1.9	£2.1	£2.2	£2.4	£2.5	£2.6	£2.4	£2.2	£2.3	£2.8	£2.9	£2.5
£ / year / m2	£7	£5	£5	£6	£6	£6	£5	£4	£4	£4	£5	£5	£4	£7	£5
£ / year / m2	£12	£10	£9	£10	£10	£11	£12	£10	£10	£10	£12	£11	£10	£11	£11
vs Baseline		-14%	-18%	-9%	-10%	-5%	-2%	-18%	-19%	-18%	-5%	-8%	-15%	4%	-8%

Figure 45 - 2008-2022 Utilities Cost in £/year/m2

Each m2 of building cost us £21/year in utilities.

7.4 Utilities Consumption, Costs and Carbon emissions Pie Charts

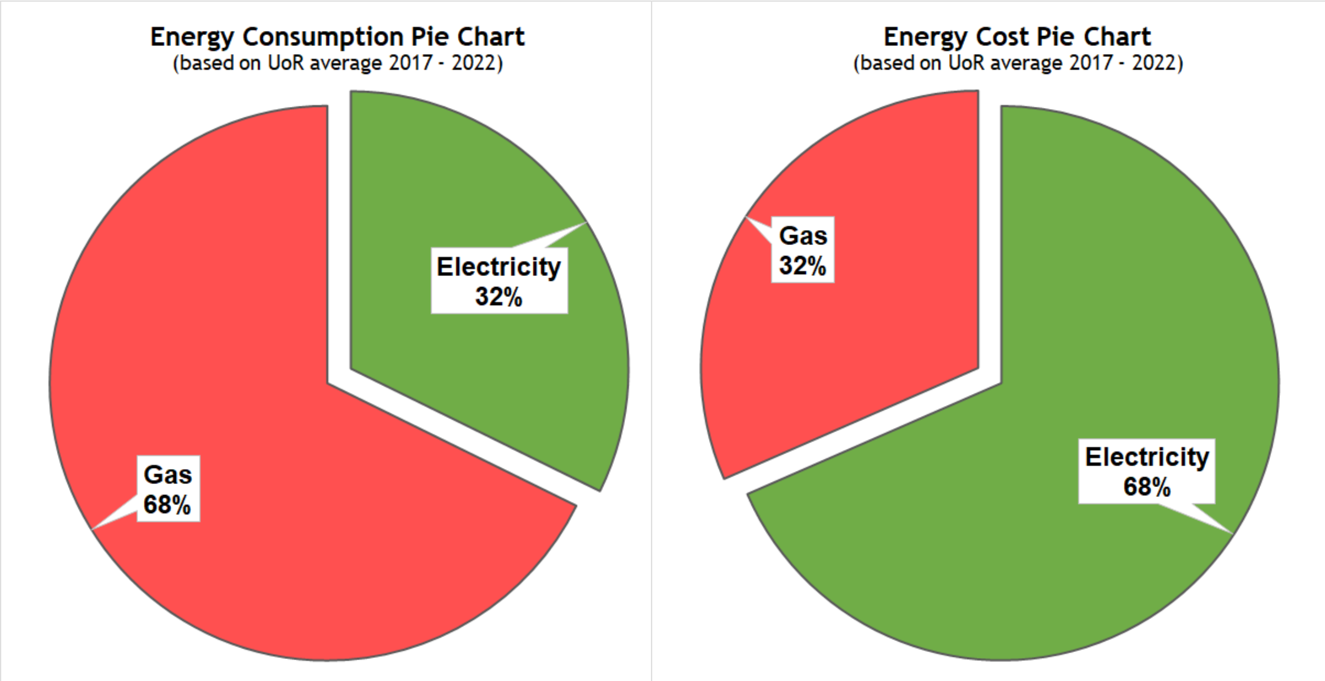


Figure 46 – Energy Consumption and Energy Cost Pie Charts

Electricity represents only 32% of our energy consumption but 68% of our energy costs. Indeed electricity is typically 4 times more expensive than gas (see Figure *14* and Figure *24*). This is in turn makes electricity savings projects financially more valuable.

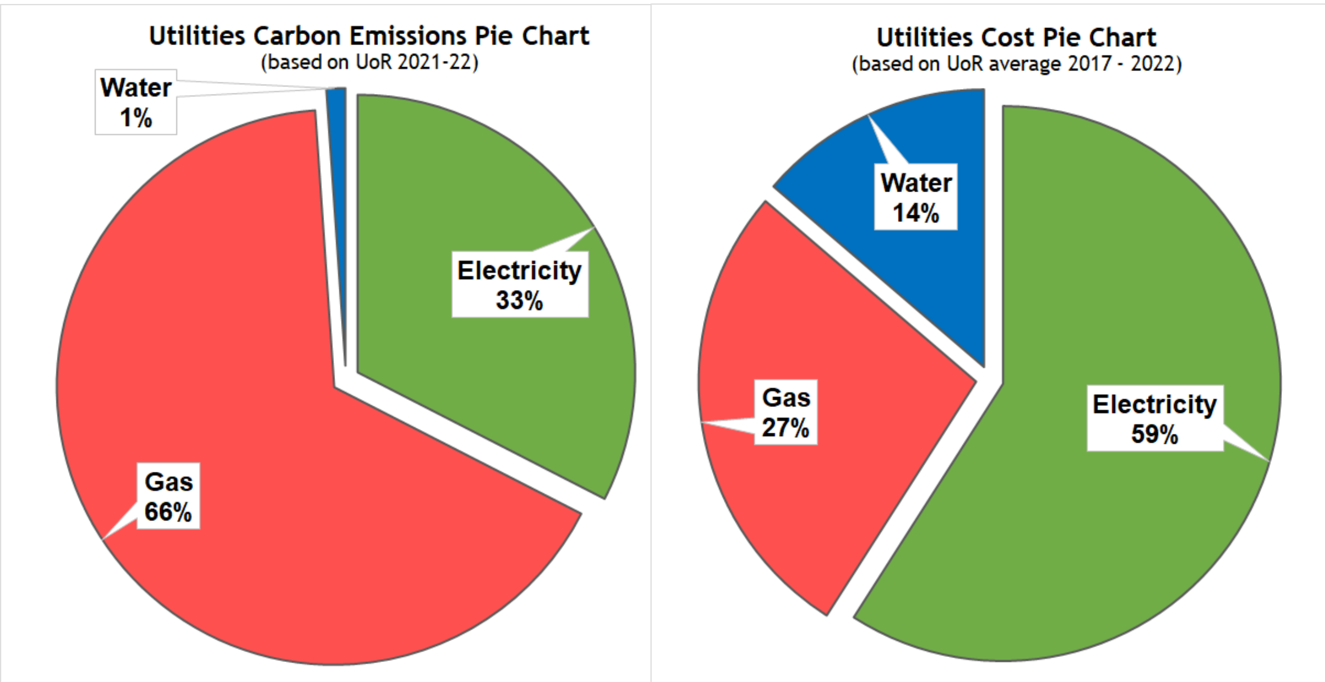
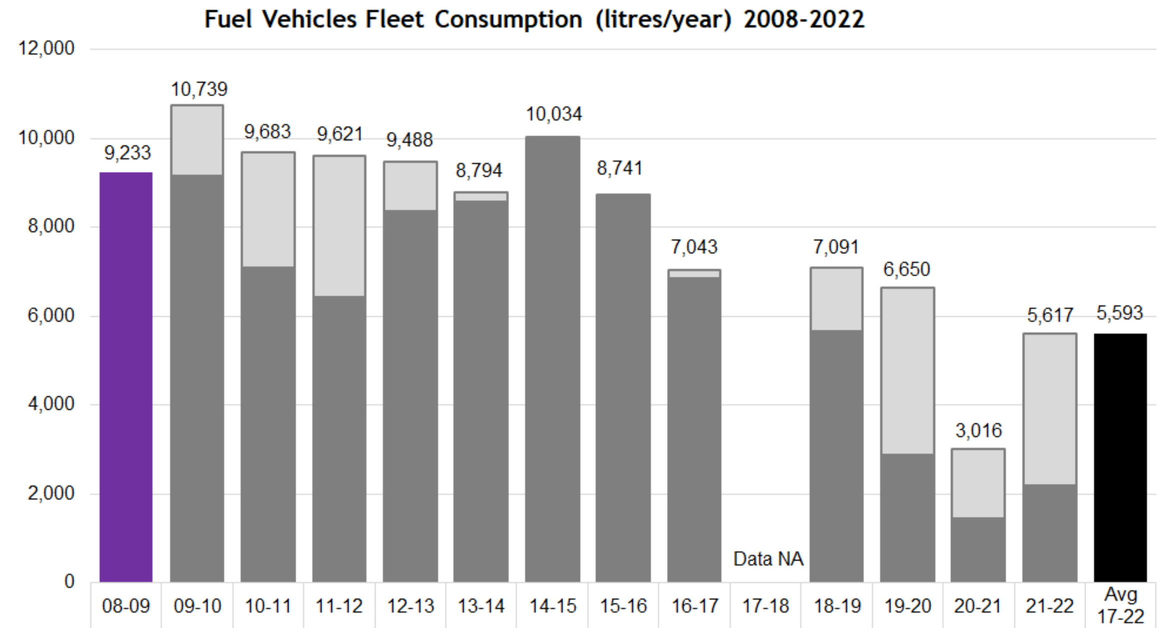


Figure 47 - Utilities Carbon Emissions and Utilities Cost Pie Charts

Gas represents 68% of our energy consumption and 66% of our utilities carbon emissions. Indeed the electricity carbon factor and gas carbon factor are now very close (Figure 02 and Figure 03). This is in turn makes gas savings projects more valuable from a usage reduction and carbon emissions perspective.

8. Fuel Vehicles Fleet

8.1 Fuel Consumption analysis

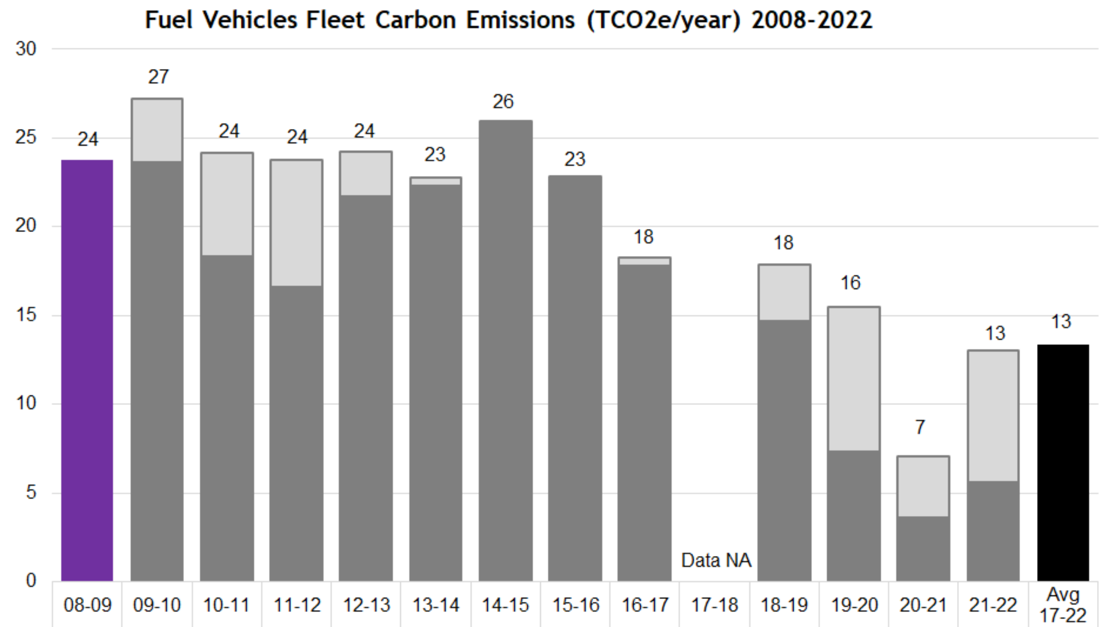


	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Avg 17-22
Petrol (litres/year)	339	1,593	2,581	3,202	1,133	224	0	22	185	0	1,419	3,775	1,583	3,418	2,549
Diesel (litres/year)	8,894	9,146	7,102	6,419	8,354	8,570	10,034	8,719	6,858	0	5,672	2,875	1,432	2,199	3,044
vs Baseline		16%	5%	4%	3%	-5%	9%	-5%	-24%	0%	-23%	-28%	-67%	-39%	-39%

Figure 48 - 2008-2022 Fuel Vehicles Fleet Consumption (litres/year)

Overall our usage of fuel for our own vehicles fleet (post, security and maintenance vans) have reduced by -39% vs 2008-09 baseline. In average (over the last 5 years) we use nearly 5,600 litres of fuel per year for our vehicles fleet.

8.2 Fuel Carbon emissions analysis



	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Avg 17-22
Petrol (TCO2e/year)	1	4	6	7	3	0	0	0	0	0	3	8	3	7	6
Diesel (TCO2e/year)	23	24	18	17	22	22	26	23	18	0	15	7	4	6	8
vs Baseline		15%	2%	0%	2%	-4%	9%	-4%	-23%	0%	-25%	-35%	-70%	-45%	-44%

Figure 49 - 2008-2022 Fuel Vehicles Fleet Carbon Emissions (TCO2e/year)

As we have seen fuel usage has decreased by -39% and the diesel/petrol carbon factors (how much carbon emissions is to be associated with the use of 1litre of diesel/petrol in the UK) is ever so slightly lower but virtually the same (Figure 05). As a result of these two trends, the company's associated carbon emissions for its use of vehicles fleet fuel are -45% lower in 21/22 (13 TCO2e) than in 08/09 (24 TCO2e), as shown in Figure *49*.

9. Increase in the Estates size: impact on Utilities

In average (2017-22), the construction of Chadwick, Elm Grove and the new Library (New Estates) added +24% on utilities consumption (+4761 MWh/yr), costs (+393k£/yr) and carbon emissions (+1003 TCO2/yr).

	Elec			Gas			Water		
Consumption	+27%	+1,674	MWh/yr	+23%	+3,087	MWh/yr	+23%	+21,768	m3/yr
Cost	+28%	+257	k£/yr	+17%	+80	k£/yr	+26%	+57	k£/yr
Carbon emissions	+26%	+422	TCO2/yr	+23%	+566	TCO2/yr	+20%	+15	TCO2/yr

	Energy			All Utilities		
Consumption	**+24%**	+4,761	MWh/yr			
Cost				**+24%**	+393	k£/yr
Carbon emissions				**+24%**	+1,003	TCO2/yr

10. ON-SITE SOLAR ELECTRICITY GENERATION

We have 4 Solar Photovoltaic (PV) installations ☀ Overall we produce about 157MWh/year of solar electricity on-site (about 2% of our electricity demand) which saves nearly £30,000/year.

Library North (July 2017)

Library South (March 2019)

Lakeside (March 2019)

Davies (March 2019)

11. Utilities Savings and Management: Completed Projects 2010 – 2022

A full breakdown of all completed projects[6] is in appendix. They sum up as below:

	Costs			Savings				
	Total Invested	Salix funding	UoR funding	Energy (MWh)	Financial as at project closure	Financial as at FY23-24 expected utilities prices	TCO_2 as at project closure	TCO_2 as at 2022 carbon factors
61 projects	£3.4M	£2.7M	£0.7M	5,001	£710k	£1,294k	1,927	1,018
		80%	20%					
Equiv. to the average annual energy consumption of				313	households in the UK			

In the **last 13 years** the University has **invested £3.4million** in **61 projects** with 5 to 10 years payback to reduce utilities usage, associated costs and carbon emissions. 80% was funded from Salix interest-free loans and revolving funds, successfully applied for and managed in-house[7].

Annual energy savings are totalling 5000 MWh/year which is **equivalent of powering and heating 313 UK homes for a year.**

Energy Management is saving the University of Roehampton £530,000 in utilities every year (as calculated with utilities prices at the time of project closure) **which is valued today at £1.3M p.a.** with the current energy prices crisis. We currently expect to pay nearly **£4M** for our **energy in FY23-24**. This means, **should we have not 'invested to save' we would be faced with a £5.3M energy expenditure.**

In addition, one-off refunds/savings totalling £180,000 were realised by analysing and challenging erroneous/overcharges in utilities bills.

These substantial results were achieved with only 1 Energy Manager and some Project Management support.

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[6] Savings in kWh are calculated savings (validated by external verification and/or energy monitoring).
Savings in £ at project closure are based on an average expected energy price for the 5-8 years after the project completion at 2% inflation p.a. (as per Salix rules).
Savings in £ as at FY23-24 expected utilities prices are as per energy broker EIC market data for FY23-24 and UoR budget submitted 10.03.2023. Energy Crisis prices.

[7] The Energy Manager is the Salix Fund Manager and deal with all internal and external communications and reporting requirements to Salix Finance Ltd.

SUB-TOTAL : Annual savings	Costs			Savings						Payback (years)	Utility affected	Completed
	Project Cost (£ inc. VAT)	Salix funding (£ inc. VAT)	UoR funding (£ inc. VAT)	Energy (kWh) or Water (m3)	Financial (£) as at project closure	Financial (£) as at FY23-24 expected utilities prices	TCO_2 as at project closure	TCO_2 as at 2022 carbon factors	One-off or annual			
Sub-total : Elec	£2,999,270			3,244,837	£436,399	£1,061,948	1,596	685	Annual		Elec	2010 - to date
Sub-total : Gas	£379,586			1,755,920	£59,432	£147,497	323	321	Annual		Gas	2010 - to date
Sub-total : Water	£3,446			29000 m3	£34,000	£84,680	8	12	Annual		Water	2010 - to date
	£3,382,302	£2,694,226	£688,076		£529,831	£1,294,125	1,927	1,018		6		
		80%	20%									

Figure 50 – 2010-2022 Total Annual recurring utilities savings thanks to Energy Management

In total, thanks to our 'invest to save' projects and proactive utilities management, the equivalent of **1018 tonnes of CO2 p.a.** (as at current 2022 carbon factors) is **not released into the atmosphere** which alone **reduce our current carbon footprint by -18%.** This means, **should we have not 'invested to save' our Utilities Carbon Emissions, currently at 4725 TCO2e/year would be 5743 TCO2e/year.**

SUB-TOTAL : One-off savings	Costs			Savings						Payback (years)	Utility affected	Completed
	Project Cost (£ inc. VAT)	Salix funding (£ inc. VAT)	UoR funding (£ inc. VAT)	Energy (kWh) or Water (m3)	Financial (£) as at project closure	Financial (£) as at FY23-24 expected utilities prices	TCO_2 as at project closure	TCO_2 as at 2022 carbon factors	One-off or annual			
Sub-total : Elec	Staff time		Staff time	NA	£169,916	NA	NA	NA	One-off		Elec	2010 - to date
Sub-total : Gas	Staff time		Staff time	NA	£8,956	NA	NA	NA	One-off		Gas	2010 - to date
Sub-total : Water	Staff time		Staff time	NA	£1,500	NA	NA	NA	One-off		Water	2010 - to date
	Staff time		Staff time		£180,372							

Figure 51 – 2010-2022 Total One-off utilities bills refunds/savings thanks to Energy Management

SUB-TOTAL : Per Type of Key Projects			Costs		Savings							Payback (years)	Utility affected	Completed
			Project Cost (£ inc. VAT)	% of total invested	Energy (kWh) or Water (m3)	Financial (£) as at project closure	Financial (£) as at FY23-24 expected utilities prices	TCO_2 as at project closure	TCO_2 as at 2022 carbon factors	One-off or annual				
Voltage Optimisation	7	Substation	£286,494	8%	881,150	£84,553	£278,443	477	186	Annual	3	Elec	2009 - 2011
Lighting	14,309	Luminaires	£2,468,977	73%	2,206,498	£294,632	£697,253	1,073	466	Annual	8	Elec	2010 - to date
Thermostatic Radiator Valves (TRV)	1,755	Radiator valves	£240,254	7%	672,934	£23,553	£56,526	123	123	Annual	10	Gas	2012 - 2013
Loft insulation	4,000	m2 of loft insulation	£32,250	1%	51,283	£1,795	£4,308	9	9	Annual		Gas	2012
Pipework and fittings insulation	1,875	Meters of insulation	£72,339	2%	806,703	£28,234	£67,763	149	147	Annual	3	Gas	2012 - 2015
Solar PV	650	Solar PV panels	£239,397	7%	145,789	£26,106	£46,069	40	31	Annual	9	Elec	2019

Figure 52 – 2010-2022 Capital invested and Annual Utilities Savings per Project Type

Type of key projects:

- ✓ Over 14,000 lighting replacements to LED with motion and daylight controls
- ✓ 508m2 of Solar Electricity panels installed
- ✓ 1750 Thermostatic Radiator Valves installed
- ✓ Voltage Optimisation of our 7 main electricity supplies
- ✓ 4000m2 of 30cm thick loft insulation in all buildings with unoccupied pitched roofs
- ✓ 1875m of heating pipework insulated
- ✓ Draught proofing of 615 windows and doors
- ✓ Detection and repair of gas and water leaks

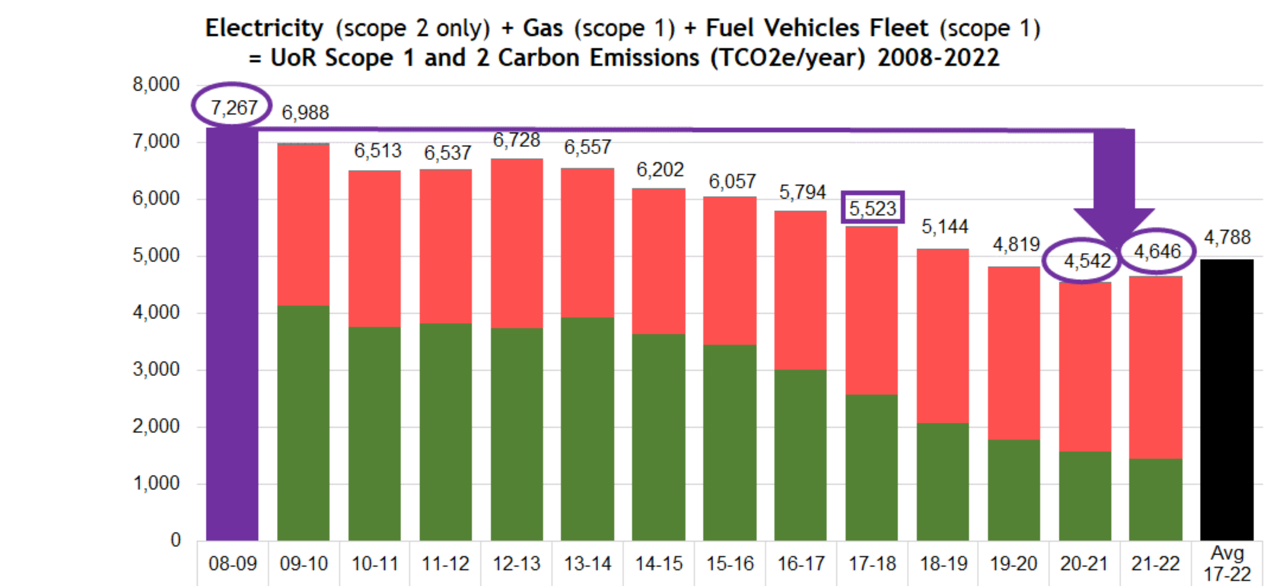
Of all projects, the predominant type was **lighting** with **73% of the total invested** (23 projects) replacing **in total over 14,000 luminaires** to **quality, long lasting and energy-efficient LED** luminaires **with motion and daylight sensors**. Each project typically reduces electricity used for lighting by 80%, with invaluable maintenance benefits with much reduced re-lamping.

12. Scope 1 and 2 carbon emissions – have we achieved our targets?

For a definition of Scope 1, 2 and 3, see Glossary in Appendix.

Whilst section 7.2 present all utilities related carbon data, it includes scope 3 Electricity carbon emissions (related to its transport and distribution) and Water/Wastewater which are scope 3, and misses Vehicles Fleet Fuel related carbon data which fall under scope 1.

Scope 1 and 2 only are mandatory to report and our targets are set against these so what are exactly our scope 1 and 2 emissions? Have we achieved our 2020 target? Are we on track to reach our 2025 target?



	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Avg 17-22
TCO2e / year	24	27	24	24	24	23	26	23	18	18	18	16	7	13	13
TCO2e / year	2,736	2,827	2,722	2,687	2,975	2,617	2,551	2,588	2,764	2,946	3,062	3,030	2,970	3,198	3,041
TCO2e / year	4,507	4,134	3,767	3,827	3,729	3,917	3,625	3,446	3,011	2,559	2,064	1,774	1,564	1,436	1,879
vs 08-09 Baseline		-4%	-10%	-10%	-7%	-10%	-15%	-17%	-20%	-24%	-29%	-34%	-38%	-36%	-34%
vs 17-18 Baseline											-7%	-13%	-18%	-16%	-13%

Figure 53 - 2008-2022 Scope 1 and 2 Carbon Emissions (TCO2e/year) reduction in absolute terms

Scope 1 and 2 carbon emissions have reduced by -38% in absolute terms from 7,267 in 08-09 to 4,542 TCO2e/year in 20-21[8] **i.e. despite a 31% increase in the Estates size** which has added +24% on utilities carbon emissions (+1003 TCO2/yr), **we have nearly reached our -40% '2020' scope 1 and 2 carbon reduction target set in our 2011 Carbon Management Plan !**

This is mainly **thanks to our continuous efforts to save electricity, helped by the decarbonisation of the UK Grid Electricity.**

Whilst there is a lot more to do and at a much higher speed to reach 'Net Zero' this is a **very significant achievement for University of Roehampton whom employ <u>only 1 member of staff</u> to manage a vast range of utilities activities and reduce its usage.**

[8] We report here against 20-21 as we have seen a particular rise in gas usage in 21-22 which is the main reason for emissions to rise again in that year and it is thought to be due to the exceptional impact additional ventilation requirement for COVID risks mitigation had on gas usage for space heating. We have reasonable hope for usage to return to 20-21 levels in 22-23.

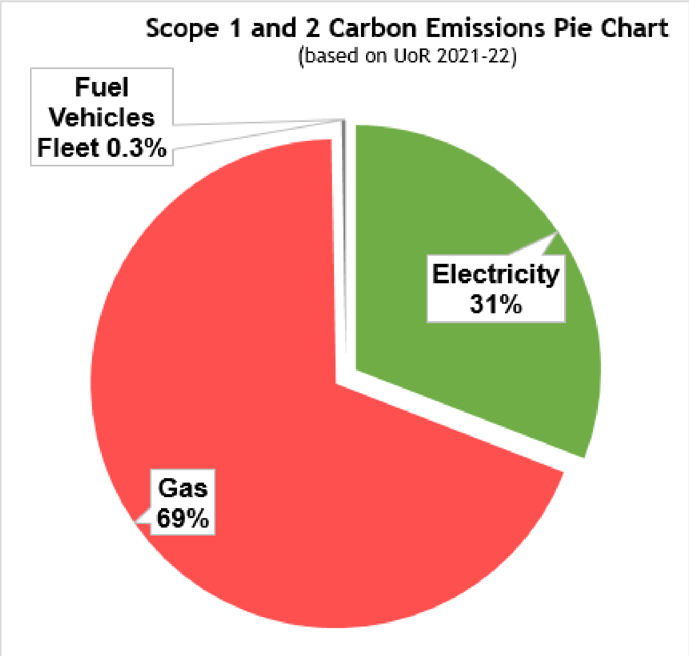
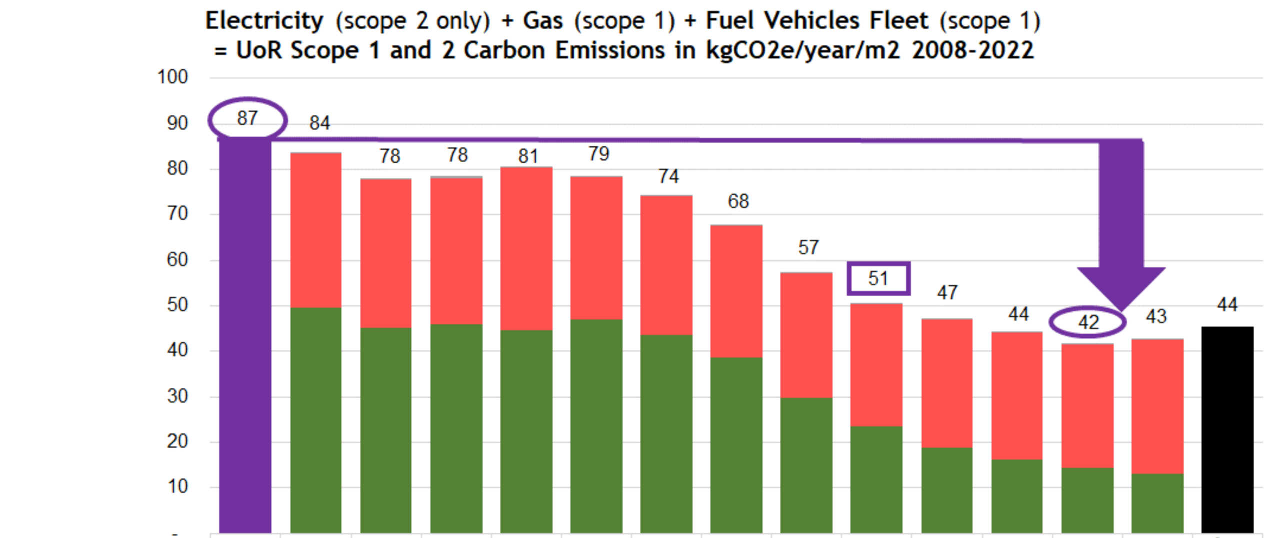


Figure 54 – Scope 1 and 2 Carbon Emissions Pie Chart

The highest proportion of our scope 1 and 2 carbon emissions is for Gas at 69%, followed by Electricity at 31% and Fuel Vehicles Fleet at only 0.3%. This mean from a carbon emissions reduction perspective our focus should be on gas savings projects. (However not necessarily the easiest/quickest and cheapest type of projects to realise).



	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Avg 17-22
■ kgCO2e / year / m2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.1
■ kgCO2e / year / m2	33	34	33	32	36	31	31	29	27	27	28	28	27	29	28
■ kgCO2e / year / m2	54	50	45	46	45	47	43	39	30	23	19	16	14	13	17
vs 08-09 Baseline		-4%	-10%	-10%	-7%	-10%	-15%	-22%	-34%	-42%	-46%	-49%	-52%	-51%	-50%
vs 17-18 Baseline											-7%	-13%	-18%	-16%	-13%

Figure 55 - 2008-2022 Scope 1 and 2 Carbon Emissions (kgCO2e/year/m2) reduction in relative terms

In relative terms, scope 1 and 2 carbon emissions are 52% lower (at 42 kgCO2e/year/m2) **than in our 2008-09 baseline year** (at 87 kgCO2e/year/m2)**. In relative terms our -40% '2020' target has been overachieved!**
Scope 1 and 2 carbon emissions per square meter are 18% lower than in 2017-18 baseline year (at 51 kgCO2e/year/m2). **We are nearly 'on track' for our -25%** (scope 1 and 2 per m2) **2025 carbon reduction target set in our 2019 Enabling Strategies.** There is less than 3 years to achieve a further -9% reduction at organisation level.

13. How far are we from reaching Net Zero by 2050?

We've all heard the term **Net Zero**, but **what exactly does it mean?**

Put simply, net zero refers to the balance between the amount of greenhouse gas (GHG) that's produced and the amount that's removed from the atmosphere. It can be achieved through a combination of emission reduction and emission removal.

As opposed to the term '**Carbon Neutral**', which refers to the ambition to limit any increase in future carbon emissions while using offsets to neutralise existing emissions, '**Net zero**' places much more focus on reducing carbon emissions as much as possible first, and only offsetting unavoidable, residual CO2 as a last resort.

In June 2019 the UK became the first major economy in the world to pass net zero emissions law to end its contribution to global warming by 2050. In April 2021 it announced it would enshrine a new target in law to slash emissions by 78% by 2035 to bring the country more than three-quarters of the way to net zero by 2050.

So, how much more could we reduce our scope 1 and 2 carbon emissions?

Whilst this is the purpose of our Net Zero Strategy (identify opportunities, quantify savings, investments and resources, and prioritise actions) we have attempted below, using some of the useful metrics of this report, to high-level assess the impact of a few significant pathways to a lower carbon future at University of Roehampton.

Potential for further utilities savings and carbon emissions reductions by 2050

				Utility affected
1	⇨	Complete LED Lighting + sensors Programme		ELEC
2	⇨	Space rationalisation		Heating mainly usually GAS and ELEC, WATER
3	⇨	Campus-wide BMS Centralisation + Upgrade/Expansion or Local Heating Controls		Heating mainly usually GAS
4	⇨	Buildings Insulation Retrofit Programme to the EnerPHIT standard		Heating usually GAS
5	⇨	Replacement of Space Heating Gas boilers by Electric Heat Pumps		GAS down ELEC up
6	⇨	Further UK Electricity Grid Decarbonisation		ELEC Carbon Content
7	⇨	Own Vehicles Fleet goes Electric (EV)		PETROL DIESEL FUEL down ELEC up
8	⇨	Expand on-site Solar Electricity generation		ELEC

The above opportunities are probably the ones with the most impact.

There are many other utilities savings opportunities we can consider such as, to name just a few: variable speed pumps ; electrical equipment rationalisation inc. portable electric heaters and air-conditioning units ; white goods replacement to more energy-efficient models ; computer and display screens power management software ; hot water dispenser disconnections? ; analysing utilities data patterns to find out (sooner) about water and gas leaks ; staff/students behaviour awareness campaigns, etc. etc.
We had attempted to list these in our 2011 Carbon management Plan (p41 "Overview of carbon saving opportunities"). Together they will no doubts present valuable additional utilities/carbon savings benefits.

It is one of the main purpose of our Net Zero Strategy, yet to be developed, to provide a 'shopping list' of assessed utilities/carbon saving projects to get us as close as possible to these very ambitious goals. It would provide the University with some readiness and a fighting chance to secure rounds of 'green funding' when released e.g. the Public Sector Decarbonisation Scheme (PSDS) released by BEIS and managed by Salix Finance Ltd.

Commenting on the above pathways: **Electricity reducing measures** are ***somewhat easier* to implement and fund** with likely quicker returns on investments. However, with 69% of our scope 1 and 2 carbon emissions for gas, **from a carbon emissions reduction perspective, our focus should be on reducing gas usage.**

As **about 70% of our gas usage is to heat spaces** (as it typically is) our focus should be on **Heat Decarbonisation Plans/Projects** which government funding has started to target. This would involve technical and financial surveys to **embark at scale on a Buildings Insulation Retrofit Programme to the** EnerPHIT standard (measure 4) coupled with **replacing Space Heating Gas boilers by Electric Heat Pumps** (measure 5). A **working Campus-wide Building Management System (BMS) Centralisation + Upgrade/Expansion** or Local Heating Controls, allowing to adjust remotely and dynamically heating/cooling times/settings to actual needs/buildings occupation (measure 3). And some **Space Rationalisation** by way of more office space sharing and some older building(s) closures.

Heat Decarbonisation measures represent a significant opportunity but a significant challenge.

Heat pumps are 'low-grade heat' (lower supply temperatures than gas boilers) which means to avoid users discomfort/complaints, they **can't be installed in buildings with high heat losses i.e. buildings should be insulated first**. That also mean they don't respond as quickly than gas boilers to changes in heat demands and need to run for longer i.e. are not very suitable/economical for buildings with very intermittent occupation.

Over 1/3 of our buildings stock (about 23 buildings) need a 'whole building approach' energy-retrofit following the motto "*do it right, do it once*". The potential for energy reduction is as huge as the challenge. Financially - simple paybacks are typically 50+ years. Based on £1500 to £2500/m2 of refurbishment costs, we have **guesstimated** that this would probably require **in the range of £60M to £100M investment - how to fund it?** Time-wise/Operationally - 23 buildings to energy retrofit in about 23 years (2050 target) i.e. **1 building/year**, ideally, for climate change mitigation, sooner/faster - **how to deliver it? Is that feasible?** This element will very much link with the long-term Estates Strategy.

The existing BMS is fairly basic and have suffered 20 years of service life with inexistent to poor management/maintenance, with the exception of in new builds where an essential part of the jigsaw for energy management and maintenance is missing at it is not centralised and accessible remotely at all. It is a fairly **technical/complex, multi-year, inter-departmental Estates-IT project** that would bring valuable energy/maintenance/users satisfaction benefits but **need human project resources and capital investment**.

Space rationalisation finally we feel is **fairly easy in comparison and rather effective** in the case of buildings decant/closure.

Potential negative impacts on utilities consumption and carbon emissions by 2050 (these were not accounted for in our high-level calculations):

⇨ Increase in the size of the Estates.
⇨ Electric Vehicles charging on campus for staff and students.
⇨ More equipment, more students/staff.

It must be noted that, whilst there is some logic and basis for our calculations, without the necessary survey details, the below use a number of assumptions, merit to be further developed and externally verified, and so is indicative at this stage.

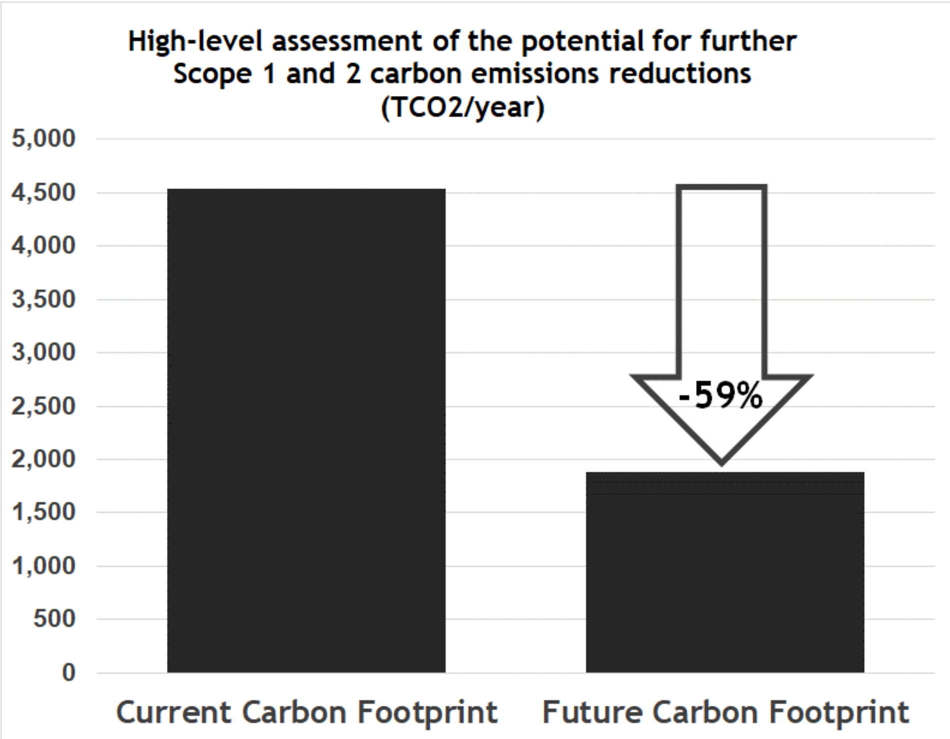


Figure 56 - High-level assessment of the potential for further carbon emissions reductions

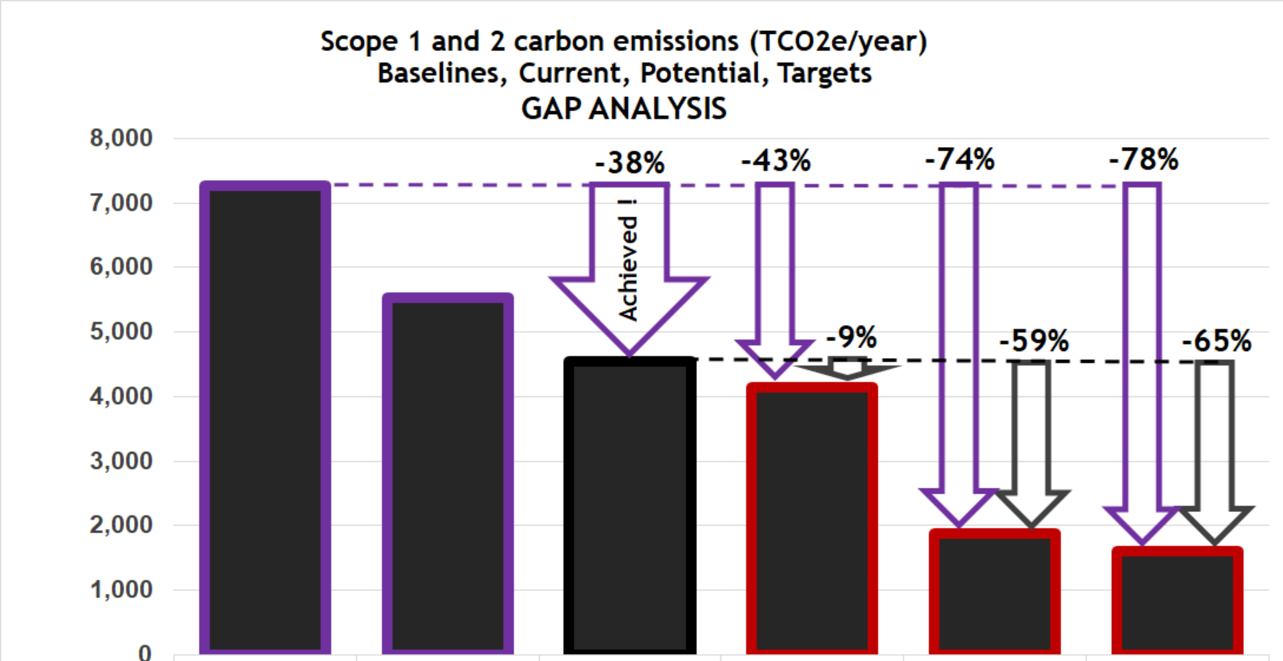
We think the 7 measures listed further above, together with the **UK plans to further decarbonise the production of electricity by half**, could further reduce our scope 1 and 2 carbon footprint by about 60%.

Achieving this (!) would represent a -74% reduction vs our FY08-09 baseline which, with some of the other measures not assessed (high-level) would see us meeting the -78% target set by the UK government, with the remainder 'hard to reach' or 'necessary for our operations' to be offset in order to reach Net-Zero.

Our scope 1 and 2 carbon footprint:

- **was 7,267** TCO2e/year in 08-09
- **currently is 4,542** TCO2e/year (-38%)
- **need to reach 4,142** TCO2e/year (-43%) **by 2025** to meet UoR Enabling Strategy Target
- **need to,** and in theory can, **reach 1,599** TCO2e/year (-78%) **to meet UK Target / Net Zero**

The UoR Enabling Strategy Target is on the right trajectory to achieve -78% by 2050, however not reaching far enough to achieve -78% by 2035 (Figure *58*).



	FY08-09 Baseline Carbon Footprint	FY17-18 Baseline Carbon Footprint	Current Carbon Footprint	UoR Enabling Strategy Target* by 2025	8 Pathways High-Level assessment of the potential for further reductions	78% UK Target by 2035
TCO2e/year	7,267	5,523	4,542	4,142	1,878	1,599
vs FY08-09			-38%	-43%	-74%	-78%
vs FY17-18			-18%	-25%		
vs current				-9%	-59%	-65%

Figure 57 - Scope 1 and 2 carbon emissions - Baselines, Current, Potential, Targets - Gap Analysis

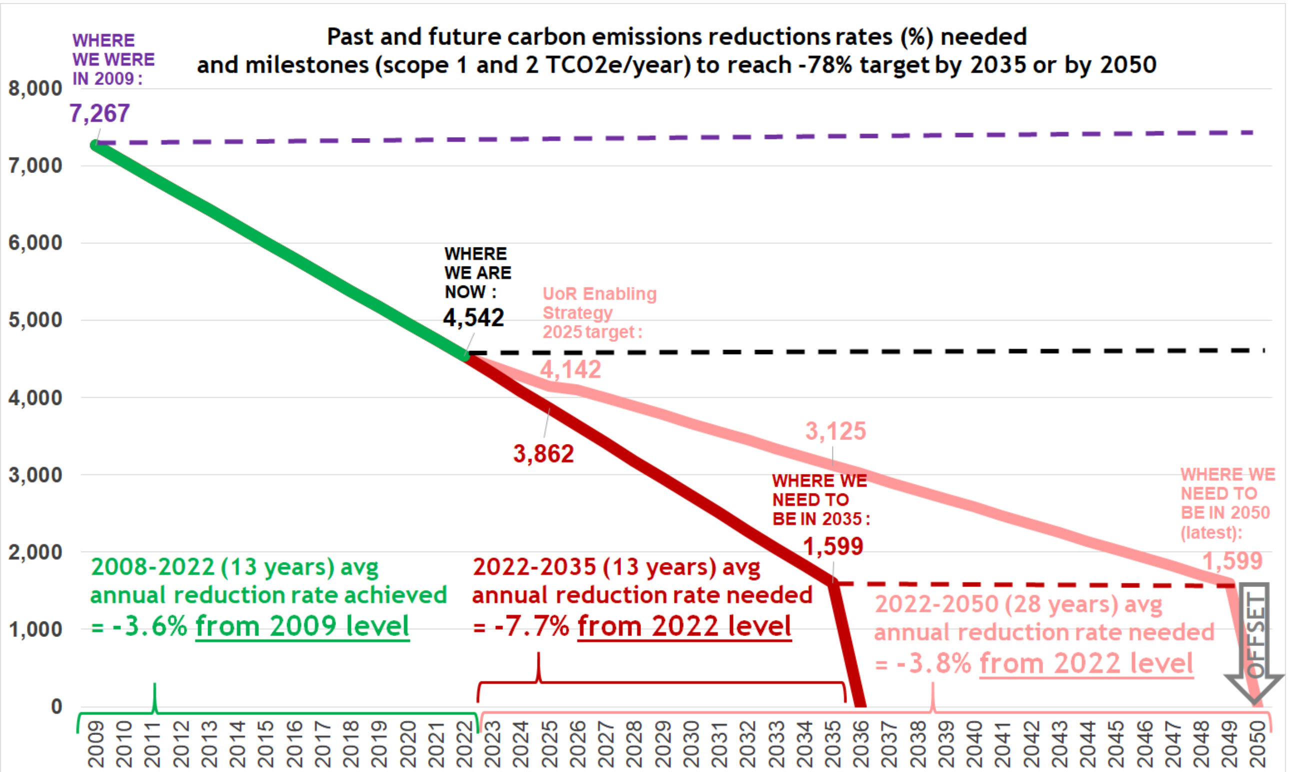


Figure 58 - Past and future reductions rates (%) needed and milestones for -78% by 2035 or by 2050

Figure 58 represents the **size of the challenge**:

- Our -38% absolute reduction 2009-2022 (13 years) translate into an **average reduction rate of -3.6% per year, from 2009 levels**.

- To achieve the -78% UK target and Net Zero by 2050 at the latest, we need to further reduce at an **average reduction rate of -3.8% per year, from 2022 levels**.

- To achieve the -78% UK target and Net Zero by 2035 as set in the law, we need to further reduce at an **average reduction rate of -7.7% per year, from 2022 levels**.

Inevitably, with the exhaustion of 'low hanging fruits' ('easier' to implement energy/carbon savings projects), **it will become much harder in time to even 'just' achieve a similar average reduction rate (-3.8%) to what we have already achieved (-3.6%)** and from a lower starting point too (from 2022 level as opposed to from 2009 level).

To effectively mitigate the environmental and financial impact of **climate changes** for all life on earth **we should follow the very challenging average reduction rate of -7.7% per year, from 2022 levels.**

It is the **main purposes of our Net Zero Strategy** yet to be developed, in line with other University Strategies such as the Estates Strategy, to identify different pathways to achieve these ambitious goals, quantify savings, assess at least at high-level technical and financial viability of a wide range of carbon savings projects/options and prioritise them, in discussion with Executives, for action.

A robust Strategy will provide the University with some readiness and a fighting chance to secure 'green funding' when released e.g. the Public Sector Decarbonisation Scheme (PSDS) provided by BEIS and managed by Salix Finance Ltd.

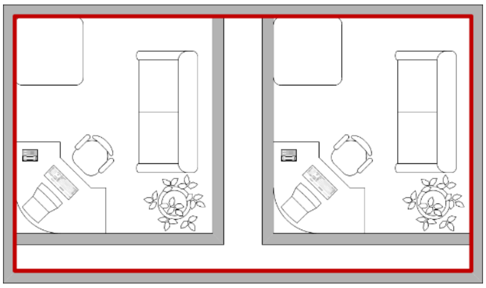
Glossary of terms

❖ **Scope 1, 2 and 3 carbon emissions -**

Greenhouse gas emissions are categorised into three groups or 'scopes' by the most widely-used international accounting tool, the Greenhouse Gas (GHG) Protocol. Scope 1 and 2 are those emissions that are owned or controlled by an organisation (at UoR emissions from burning gas for heating/hot water/catering, fuels for our vehicle fleet and from the generation of purchased electricity), whereas scope 3 emissions are a consequence of the activities of the company but occur from sources not owned or directly controlled by it (e.g staff and students commuting, air and land-based business travel, water supply and wastewater treatment, transportation and distribution of electricity, waste and procurement). 3min video that explains scopes 1, 2, 3.

❖ **Gross Internal Area (GIA) -**

GIA is the total area of buildings owned, occupied or maintained by the organisation. GIA is measured to the internal face of the perimeter walls at each floor level (i.e. the footprint of the building excluding the width of the outside walls). It includes areas occupied by internal walls and partitions.



❖ **Carbon Factor -**

A Carbon Factor is a coefficient (in kg of CO2equivalent) that describes the quantity of greenhouse gases (GHGs) released into the atmosphere by a given activity. E.g. how much carbon emissions are to be associated with the use of 1 kWh of grid electricity, 1 kWh of gas or 1m3 of water, in the UK. The electricity carbon factor e.g. is a representation of the carbon impact of using 1 kWh of grid electricity in the UK i.e. how much pollution is emitted for that electricity to be generated and transported to us. There is a carbon factor for a number of usages: elec, gas, water, wastewater, fuels and many more. UK Carbon Factors are reviewed annually and available at https://www.gov.uk/government/collections/government-conversion-factors-for-company-reporting

❖ **Green gas -**

Green gases are renewable and low carbon gases that can be used in place of fossil fuels, reducing carbon emissions. They include biomethane, bio-propane, and hydrogen.

❖ **What is a kWh -** https://www.youtube.com/watch?v=zRYESRObKqA

❖ **CHP -** Combined Heat and Power plant.

❖ **BMS -** Building Management System.

❖ **Net Zero and related terms -**

https://www.nationalgrid.com/stories/energy-explained/what-is-net-zero
https://netzeroclimate.org/what-is-net-zero/

❖ **Carbon Offsetting -**

The action of compensating for carbon dioxide emissions arising from human activity, by participating in schemes designed to make equivalent reductions of carbon dioxide in the atmosphere e.g. reforestation or creation of solar/wind/hydro sites across the world. Carbon offsetting is a mechanism used to finance greenhouse gas (GHG) emission reduction/avoidance or sequestration equivalent to the residual emissions of an organisation, business or territory beyond its value chain. This financing is achieved through the purchase of carbon credits.

Appendices

A. Utilities Savings and Management : Completed Projects : 2010 to date

B. Buildings GIA

C. Consumption Data amendments

Utilities Savings and Management : Completed Projects : 2010 to date

Project Type	Project Description	Quantity		Costs				Savings						Payback (years)	Utility affected	Completed
				Project Cost (£ inc. VAT)	Salix funding (£ inc. VAT)		UoR funding (£ inc. VAT)	Energy (kWh) or Water (m3)	Financial (£) as at project closure	Financial (£) as at FY23-24 expected utilities prices	TCO_2 as at project closure	TCO_2 as at 2022 carbon factors	One-off or annual			
Smart Metering	Developped a smart metering system	114 (now 82)	Smart sub-meters	£85,000			£85,000								Elec, Gas, Water	2009 + 2013
Voltage Optimisation Project	Voltage Optimisation at Whitelands, Froebel Grove, Froebel Courts	3	Substation	£132,645	£132,645	RGF1		379,524	£36,434	£119,930	204	80	Annual	4	Elec	Aug-09
Voltage Optimisation Project	Voltage Optimisation at Digby South, Digby North	2	Substation	£84,203	£84,203	RGF1		299,188	£28,722	£94,543	163	63	Annual	3	Elec	Dec-09
Water leak identification and repair	Water leakage since Sept 09 Whitelands repaired	1	Water leak	NC			NC	18000 m3	£20,000	£52,560	5	8	Annual		Water	Jan-10
Voltage Optimisation Project	Voltage Optimisation at Southlands	1	Substation	£47,507	£47,507	RGF1		174,438	£16,746	£55,122	95	37	Annual	3	Elec	Apr-10
Utilities bills	Erroneous Gas bill - Wrong gas meter read given by RU at Digby			Staff time			Staff time	NA	£4,000	NA	NA	NA	One-off		Gas	Jul-10
Utilities bills	Overcharge capacity (kVA) elec. Bills 2005-2009 - EON			Staff time			Staff time	NA	£7,986	NA	NA	NA	One-off		Elec	Jul-10
Lighting Project	T5 lighting with daylight and movement sensors at parts of Lulham, Richarsdon and Queen (~50 fittings)	50	Luminaires	NC			NC	NC	NC	NC	NC	NC	Annual		Elec	Aug-10
Lighting Project	T5 lighting with daylight and movement sensors at LRC (1643 -> 948 fittings)	948	Luminaires	£237,053	£237,053	SEELS1		257,000	£30,000	£81,212	140	54	Annual	8	Elec	Oct-10
Water leak identification and repair	Water leakages repaired near Grove House and Convent	2	Water leak	£2,446			£2,446	11000 m3	£14,000	£32,120	3	5	Annual	0.2	Water	Oct-10
Draught proofing Project	Draught proofing at Fincham, Howard, Jubilee, Romero Ct, Richardson, Grove House (615 windows and doors)	615	Windows and doors	£34,743	£34,743	SEELS1		225,000	£5,850	£18,900	42	41	Annual	6	Gas	Nov-10
Utilities bills	Erroneous Water bill since Sept 09 - VAT at Arton Wilson			Staff time			Staff time	NA	£1,500	NA	NA	NA	One-off		Water	Jan-11
Utilities bills	Overcharge capacity (kVA) elec. bills 2005-2009 - EDF			Staff time			Staff time	NA	£9,100	NA	NA	NA	One-off		Elec	Feb-11
Utilities bills	Overcharge capacity (kVA) elec. bills 2005-2009 - BRITISH ENERGY			Staff time			Staff time	NA	£15,508	NA	NA	NA	One-off		Elec	Mar-11
Voltage Optimisation Project	Voltage Optimisation at Mount Clare	1	Substation	£22,139	£22,139	RGF1		28,000	£2,651	£8,848	15	6	Annual	8	Elec	Apr-11
Utilities bills	Overcharge capacity (kVA) elec. bills 2005-2009 - BRITISH ENERGY			Staff time			Staff time	NA	£13,451	NA	NA	NA	One-off		Elec	Jul-11
Lighting Project	Exterior LED lighting and controls - 120 lampost	120	Lampost	£200,000			£200,000	32,412	£17,005	£10,242	17	7	Annual	12	Elec	Sep-11
Lighting Project	T5 lighting with daylight and movement sensors at Bede, Shaw, Lee comm. areas (632 -> 369 fittings)	632	Luminaires	£74,180	£74,180	RGF1		115,131	£13,816	£36,381	63	24	Annual	5	Elec	Oct-11
Lighting Project	T5 lighting with daylight and movement sensors at Hirst, LRC, Lawrence, O.G. comm. areas (215 -> 215 fittings)	215	Luminaires	£48,033	£48,033	SEELS2		81,947	£9,834	£25,895	45	17	Annual	5	Elec	Oct-11
Utilities bills	VAT correction elec bills Opus Nov 09 - Nov 11			Staff time			Staff time	NA	£8,992	NA	NA	NA	One-off		Elec	Nov-11
Utilities bills	Lowering of max kVA levels (term of a year of 'negociation' with UKPN) on 5 out of our 6 elec supplies.	5	Substation	Staff time			Staff time		£10,000	£12,300	NA	NA	Annual		Elec	Feb-12

Project Type	Project Description	Quantity		Costs				Savings						Payback (years)	Utility affected	Completed
				Project Cost (£ inc. VAT)	Salix funding (£ inc. VAT)		UoR funding (£ inc. VAT)	Energy (kWh) or Water (m3)	Financial (£) as at project closure	Financial (£) as at FY23-24 expected utilities prices	TCO_2 as at project closure	TCO_2 as at 2022 carbon factors	One-off or annual			
Utilities reporting	Utilities Billing Validation and Management Software (TEAM Sigma)			Staff time			Staff time								Elec/Gas/ Water	Mar-12
Lighting Project	LED lighting with daylight and movement sensors at Duchesne, All Southlands, Grove House, Lulham, Davis, Roeactive comm. areas (1137 -> 777 fittings)	1137	Luminaires	£198,180	£128,180	RGF1	£70,000	214,657	£25,759	£67,832	113	45	Annual	8	Elec	Jun-12
Utilities bills	VAT correction elec bills SSE Nov 09 - Nov 11			Staff time			Staff time	NA	£100,138	NA	NA	NA	One-off		Elec	Sep-12
VSD Project	Installation of a Variable Speed Drive (VSD) at Newman Heating Pump	1	VSD	£4,402	£4,402	SEELS4		11,400	£1,368	£3,602	6	2	Annual	3	Elec	Oct-12
TRV Project	Installation of 750 Thermostatic Radiators Valves (TRV) in 7 buildings - Newman, Erasmus, Bede, Howard, LRC + Fincham, Hurst.	750	TRV	£89,007	£30,007	SEELS4	£59,000	240,603	£8,421	£20,211	44	44	Annual	11	Gas	Oct-12
Loft insulation Project	Installation of over 4,000m2 of insulation in 8 buildings lofts at Mount Clare, Cedar, Old & New Court, LRC, Richardson, Newman and Downshire	4000	m2 of loft insulation	£32,250	£8,250	SEELS4	£24,000	51,283	£1,795	£4,308	9	9	Annual		Gas	Oct-12
Pipework and fittings insulation Project	Installation of the equiv. of 656m of insulation in 11 boiler rooms (Pipes, valves and flanges) at LRC, Hurst, Jubilee, Richardson, Grove, Lawrence, Bede, Newman, Howard, Michaelis and Lulham	656	Meters of insulation	£38,246	£38,246	SEELS4		283,176	£9,911	£23,787	52	52	Annual	4	Gas	Oct-12
Lighting Project	Replacement of 2806 inefficient lamps to LED in 'non-communal' areas at Froebel Campus (2806 -> 2682)	2806	Luminaires	£144,258	£144,258	RGF1 + SEELS4		282,008	£33,841	£89,115	148	60	Annual	4	Elec	Jan-13
Water leak identification and repair	Water leakage repaired near Garden Court	1	Water leak	£1,000			£1,000	Unable to quantify	Unable to quantify	Unable to quantify			Annual		Water	Apr-13
Gas leak identification and repair	Gas leakage detected and repaired after gas meter at back of Linden	1	Gas leak	NC Tsquared Maintenance				Unable to quantify	Unable to quantify	Unable to quantify			Annual		Gas	Aug-13
Gas leak identification and repair	Gas leakage detected and repaired near large gas meter at back of Cedar	1	Gas leak	Staff time free repair from National Grid				Unable to quantify	Unable to quantify	Unable to quantify			Annual		Gas	Sep-13
Pipework and fittings insulation Project	Installation of the equiv. of 562m of insulation in Grove House Basement (Pipes, valves and flanges).	562	Meters of insulation	£6,000			£6,000	254,470	£8,906	£21,375	47	46	Annual	1	Gas	Sep-13
TRV Project	Installation of 1005 Thermostatic Radiators Valves (TRV) in 18 buildings - Southlands, Jubilee, Romero, Richardson, Digby Chapel, New, Old and Garden Courts, Grove House, Monti Diner, Cedar, Lulham, Michaelis, Roeactive, Lawrence, Brearley, Mount Clare and Picasso buildings.	1005	Radiator valves	£151,247	£54,000	RGF1	£97,247	432,331	£15,132	£36,316	79	79	Annual	10	Gas	Oct-13
Utilities bills	Overcharge capacity (kVA) elec. bills 2009-2011 Digby - SSE			Staff time			Staff time	NA	£13,848	NA	NA	NA	One-off		Elec	Mar-14
Utilities bills	Unecessary Reactive Charges due to meter programmation at Digby South, Froebel Courts, Froebel Grove and Whitelands - savings moving forward			Staff time			Staff time	NA	£1,560	£1,919	NA	NA	Annual	0	Elec	Mar-14
Gas leak identification and repair	Gas leakage detected and repaired at large meter feeding Harvey etc., Erasmus meter, Barat House meter, Digby Trade Yard meter (flammable level), Lulham meter.	5	Gas leak	Staff time free repair from National Grid			Staff time	Unable to quantify	Unable to quantify	Unable to quantify	Unable to quantify	Unable to quantify	Annual		Gas	Sep-14

Project Type	Project Description	Quantity		Costs				Savings						Payback (years)	Utility affected	Completed
				Project Cost (£ inc. VAT)	Salix funding (£ inc. VAT)		UoR funding (£ inc. VAT)	Energy (kWh) or Water (m3)	Financial (£) as at project closure	Financial (£) as at FY23-24 expected utilities prices	TCO_2 as at project closure	TCO_2 as at 2022 carbon factors	One-off or annual			
Utilities bills	Overcharge capacity (kVA) elec. bills Digby North - SSE and Voltage Reclassification at DS North, Southlands and Whitelands			Staff time			Staff time	NA	£15,843	£19,487	NA	NA	Annual	0	Elec	Jan-15
Utilities bills	Overcharge capacity (kVA) elec. bills Digby Nov and Dec 2011 - Haven			Staff time			Staff time	NA	£893	NA	NA	NA	One-off		Elec	Jan-15
Pipework and fittings insulation Project	Installation of the equiv. of 657m of insulation in 14 boiler locations (Pipes, valves and flanges) at Lawrence, Jubilee, Erasmus, Lulham, Cedar, Queens, Duchesne, Garden Court, Old Court, New Court, Davis, Mount Clare, Whitelands.	657	Meters of insulation	£28,093	£28,093	RGF1		269,057	£9,417	£22,601	50	49	Annual	3	Gas	Feb-15
Lighting Project	LED lighting with movement sensors and scene settings in William Morris Lecture Theatre (Whitelands)	54	Luminaires	£20,930	£20,300	RGF1	£630	17,107	£2,053	£5,406	9	4	Annual	10	Elec	Feb-15
Lighting Project	LED lighting at Linden (communal areas and bedrooms).	194	Luminaires	£22,733	£14,411	RGF1	£8,322	11,889	£1,466	£3,757	6	3	Annual	16	Elec	Jul-15
Lighting Project	LED lighting at Aspen (communal areas and bedrooms).	162	Luminaires	£11,803	£11,803	RGF4		11,168	£1,377	£3,529	6	2	Annual	9	Elec	Jul-15
Lighting Project	LED lighting at Willow (communal areas and bedrooms).	162	Luminaires	£11,058	£11,058	RGF4		11,211	£1,382	£3,543	6	2	Annual	8	Elec	Jul-15
Lighting Project	LED lighting at Harvey Wired Café	75	Luminaires	£8,171	£8,171	RGF4		21,163	£2,609	£6,688	11	4	Annual	3	Elec	Jan-16
Lighting Project	LED lighting at Southlands (non-communal areas)	1226	Luminaires	£307,654	£307,654	RGF4		353,091	£43,536	£111,577	190	75	Annual	7	Elec	May-16
Utilities bills	Review Capacity Agreement from 210kVA to 80 kVA at Chadwick Halls			Staff time			Staff time	NA	£2,336	£2,874	NA	NA	Annual	0	Elec	Aug-16
Water leak identification and repair	Water leakage detected and repaired (Thames Water) Garden Court stopcock	1	Water leakage	Staff time			Staff time	Unable to quantify	Unable to quantify	Unable to quantify			Annual		Water	Sep-16
Lighting Project	LED lighting at Mandela MA003	42	Luminaires	NC			NC	NC	NC	NC	NC	NC	Annual		Elec	Sep-16
Lighting Project	LED lighting at Whitelands	3881	Luminaires	£325,595	£325,595	RGF4		325,848	£40,177	£102,968	175	69	Annual	8	Elec	Jan-17
Utilities bills	Challenge erroneous gas bill (VAT/CCL and meter reads) from Npower for Chadwick Halls 2 days in Oct 15 (when transferred over to UoR)			Staff time			Staff time	NA	£4,956	NA	NA	NA	One-off		Gas	Jan-17
Lighting Project	LED lighting at Davis Sports Hall		Luminaires	NC			NC	NC	NC	NC	NC	NC	Annual	NQ	Elec	Sep-17
Lighting Project	LED lighting with daylight and movement sensors at Lulham and Cedar	305	Luminaires	£62,273	£51,190	RGF1	£11,083	51,897	£6,399	£16,399	23	11	Annual	10	Elec	Sep-17
Water leak identification and repair	Water leak repair at Mount Clare	1	Water leakage	Staff time			Staff time	Unable to quantify	Unable to quantify	Unable to quantify			Annual		Water	Sep-17
Lighting Project	2017 Small Projects: Whitelands Blood Lab, Disabled facility, Fincham reception, Fi002, Richardson room12		Luminaires	NC			NC	NC	NC	NC	NC	NC	Annual	NQ	Elec	Nov-17
Lighting Project	LED lighting with daylight and movement sensors at Bede	425	Luminaires	£78,445	£44,430		£34,015	45,043	£5,554	£14,234	20	10	Annual	14	Elec	Apr-18
Lighting Project	LED lighting with daylight and movement sensors at Grove House, Erasmus, Jubilee and Picasso external	472	Luminaires	£124,347	£117,719		£6,628	113,290	£14,161	£35,800	36	24	Annual	9	Elec	Aug-18
Lighting Project	LED lighting MUGA	4	Lampost heads	£14,388			£14,388	3,851	£431	£1,217	2	1	Annual		Elec	Feb-19

Project Type	Project Description	Quantity		Costs				Savings						Payback (years)	Utility affected	Completed
				Project Cost (£ inc. VAT)	Salix funding (£ inc. VAT)		UoR funding (£ inc. VAT)	Energy (kWh) or Water (m3)	Financial (£) as at project closure	Financial (£) as at FY23-24 expected utilities prices	TCO_2 as at project closure	TCO_2 as at 2022 carbon factors	One-off or annual			
Solar PV	Solar PV at Davis, Library South and Lakeside buildings	650	Solar PV panels	£239,397	£226,281		£13,116	145,789	£26,106	£46,069	40	31	Annual	9	Elec	Apr-19
Lighting Project	LED lighting with daylight and movement sensors at Shaw House, Newman, Howard, Richardson and Convent Parlour	1021	Luminaires	£365,397	£297,740	RGF4	£67,657	187,452	£29,805	£59,235	47	40	Annual	12	Elec	Oct-21
Lighting Project	LED lighting with daylight and movement sensors at Mandela and Davies	378	Luminaires	£214,479	£141,935	RGF1	£72,544	70,333	£15,428	£22,225	16	15	Annual	14	Elec	Oct-22
TOTAL		**61**	**projects**	**£3,382,302**	**£2,694,226**		**£688,076**	**5,000,757**	**£710,203**	**£1,294,125**	**1,927**	**1,018**				
					80%		**20%**									
Equivalent to the average annual energy consumption of								**313**	**households in the UK**							

Savings in kWh are calculated savings (validated by external verification and/or energy monitoring).

Savings in £ are based on an average expected energy price for the 5-8 years after the project completion at 2% inflation p.a. (as per Salix rules).

SUB-TOTAL : Annual savings				Costs				Savings						Payback (years)	Utility affected	Completed
				Project Cost (£ inc. VAT)	Salix funding (£ inc. VAT)		UoR funding (£ inc. VAT)	Energy (kWh) or Water (m3)	Financial (£) as at project closure	Financial (£) as at FY23-24 expected utilities prices	TCO_2 as at project closure	TCO_2 as at 2022 carbon factors	One-off or annual			
Sub-total : Elec				£2,999,270				3,244,837	£436,399	£1,061,948	1,596	685	Annual		Elec	2010 - to date
Sub-total : Gas				£379,586				1,755,920	£59,432	£147,497	323	321	Annual		Gas	2010 - to date
Sub-total : Water				£3,446				29000 m3	£34,000	£84,680	8	12	Annual		Water	2010 - to date
				£3,382,302	**£2,694,226**		**£688,076**		**£529,831**	**£1,294,125**	**1,927**	**1,018**		**6**		
					80%		**20%**									

SUB-TOTAL : One-off savings				Costs				Savings						Payback (years)	Utility affected	Completed
				Project Cost (£ inc. VAT)	Salix funding (£ inc. VAT)		UoR funding (£ inc. VAT)	Energy (kWh) or Water (m3)	Financial (£) as at project closure	Financial (£) as at FY23-24 expected utilities prices	TCO_2 as at project closure	TCO_2 as at 2022 carbon factors	One-off or annual			
Sub-total : Elec				Staff time			Staff time	NA	£169,916	NA	NA	NA	One-off		Elec	2010 - to date
Sub-total : Gas				Staff time			Staff time	NA	£8,956	NA	NA	NA	One-off		Gas	2010 - to date
Sub-total : Water				Staff time			Staff time	NA	£1,500	NA	NA	NA	One-off		Water	2010 - to date
				Staff time			**Staff time**		**£180,372**							

Project Type	Project Description	Quantity	Costs			Savings						Payback (years)	Utility affected	Completed
			Project Cost (£ inc. VAT)	Salix funding (£ inc. VAT)	UoR funding (£ inc. VAT)	Energy (kWh) or Water (m3)	Financial (£) as at project closure	Financial (£) as at FY23-24 expected utilities prices	TCO_2 as at project closure	TCO_2 as at 2022 carbon factors	One-off or annual			

SUB-TOTAL : Per Type of Key Projects			Costs			Savings						Payback (years)	Utility affected	Completed
			Project Cost (£ inc. VAT)	% of total invested		Energy (kWh) or Water (m3)	Financial (£) as at project closure	Financial (£) as at FY23-24 expected utilities prices	TCO_2 as at project closure	TCO_2 as at 2022 carbon factors	One-off or annual			
Voltage Optimisation	7	Substation	£286,494	8%		881,150	£84,553	£278,443	477	186	Annual	3	Elec	2009 - 2011
Lighting	14,309	Luminaires	£2,468,977	73%		2,206,498	£294,632	£697,253	1,073	466	Annual	8	Elec	2010 - to date
Thermostatic Radiator Valves (TRV)	1,755	Radiator valves	£240,254	7%		672,934	£23,553	£56,526	123	123	Annual	10	Gas	2012 - 2013
Loft insulation	4,000	m2 of loft insulation	£32,250	1%		51,283	£1,795	£4,308	9	9	Annual		Gas	2012
Pipework and fittings insulation	1,875	Meters of insulation	£72,339	2%		806,703	£28,234	£67,763	149	147	Annual	3	Gas	2012 - 2015
Solar PV	650	Solar PV panels	£239,397	7%		145,789	£26,106	£46,069	40	31	Annual	9	Elec	2019
				90%										

University of Roehampton
Buildings List, Floors areas, Type (Updated 2022)

Campus	Building	Number of buildings	Construction Date	GIA Total (m2)	GIA Heated (m2)	Type	Type
Southlands	LAKESIDE	1	1996	1,098	1,098	CAFETERIA	OTHERS
Southlands	QUEENS	1	1996	5,841	5,603	TEACHING	OFFICES
Southlands	SOUTHLANDS RESIDENCES (Epworth, Aldersga	2	1996	5,120	5,120	RESIDENTIAL	
Southlands	SOUTHLANDS LODGES (No 76)	2	1996	200	200	RESIDENTIAL	
Digby Stuart	BARAT HOUSE	1		TBC	TBC	RESIDENTIAL	
Digby Stuart	BEDE HOUSE	1	1951	2,748	2,538	RESIDENTIAL	OFFICES
Digby Stuart	CHAPEL	1	1853	1,204	1,204	OTHERS	
Digby Stuart	CHAPEL FLAT	1		127	127	RESIDENTIAL	
Digby Stuart	ELM GROVE	1	2016	11,624	11,624	RESIDENTIAL	
Digby Stuart	ERASMUS	1	1902	1,113	1,093	OFFICES	
Digby Stuart	FINCHAM	1	1967	846	846	TEACHING	OFFICES
Digby Stuart	HOWARD	1	1782	1,417	1,396	TEACHING	OFFICES
Digby Stuart	JUBILEE	1	1909	1,536	1,446	TEACHING	OFFICES
Digby Stuart	LEE HOUSE	1	2004	5,169	5,169	RESIDENTIAL	
Digby Stuart	LIBRARY	1	2017	8,244	8,244	OFFICES	
Digby Stuart	MANDELA (DUCHESNE)	1	2007	2,134	2,134	TEACHING	OFFICES
Digby Stuart	MARY SEACOLE (HIRST)	1	1967	1,109	1,109	TEACHING	OFFICES
Digby Stuart	NEWMAN	1	1958	2,290	2,174	RESIDENTIAL	CAFETERIA
Digby Stuart	RICHARDSON	1	1956	915	915	OFFICES	
Digby Stuart	SECURITY MAIN ENTRANCE	1	1996	15	15	OTHERS	
Digby Stuart	STUART LODGE	1		99	99	CAFETERIA	
Digby Stuart	SHAW HOUSE	1	1996	3,421	3,421	RESIDENTIAL	
Digby Stuart	SIR DAVID BELL (HARVEY)	1	1962	8,092	7,024	TEACHING	OFFICES
Digby Stuart	SIR DAVID BELL (ROMERO)	1	1897	827	827	TEACHING	OFFICES
Digby Stuart	THE HIVE	1	2014	76	76	CAFETERIA	
Froebel	ASPEN	1	2001	1,250	1,250	RESIDENTIAL	
Froebel	BREARLEY	1	1969	247	247	TEACHING	OFFICES
Froebel	DAVIES	1	2004	982	982	SPORTS	TEACHING
Froebel	ENTRANCE LODGE	1	1880	87	87	RESIDENTIAL	OTHERS
Froebel	FROEBEL DINER / MONTEFIORE HALL	1	1959	1,333	1,333	CAFETERIA	OTHERS
Froebel	GARDEN COURT	1	1967	883	877	RESIDENTIAL	
Froebel	GILROY (CEDAR)	1	1967	1,017	1,017	TEACHING	OFFICES
Froebel	GROVE HOUSE	1	1777	4,172	3,695	OFFICES	TEACHING
Froebel	GROVE LODGE	1		89	89	RESIDENTIAL	
Froebel	JEBB	1	2001	273	273	TEACHING	
Froebel	LAWRENCE	1	1936	2,133	2,080	OFFICES	
Froebel	LINDEN	1	2000	922	922	RESIDENTIAL	
Froebel	LULHAM	1	1923	1,766	1,721	TEACHING	OFFICES
Froebel	MICHAELIS	1	1957	930	930	TEACHING	SPORTS
Froebel	NEW COURT	1	1929	495	495	RESIDENTIAL	OTHERS
Froebel	OLD COURT	1	1850	876	876	RESIDENTIAL	OTHERS
Froebel	MALE PRAYER ROOM (AIR RED SHELTER)	1		20	20	OTHERS	
Froebel	OLIVE GARNETT	1	1966	538	538	SPORTS	OFFICES
Froebel	WILLOW	1	2001	1,249	1,249	RESIDENTIAL	
Downshire	DOWNSHIRE HOUSE	1	1742	860	860	TEACHING	OFFICES
Downshire	CHADWICK HALLS (North, South and West Cour	3	2015	5,893	5,893	RESIDENTIAL	
Mount Clare	MOUNT CLARE RESIDENCES A BLOCK	1	1960	603	603	RESIDENTIAL	
Mount Clare	MOUNT CLARE RESIDENCES B BLOCK	1	1960	603	603	RESIDENTIAL	
Mount Clare	MOUNT CLARE RESIDENCES C BLOCK	1	1960	603	603	RESIDENTIAL	
Mount Clare	MOUNT CLARE RESIDENCES D BLOCK	1	1960	603	603	RESIDENTIAL	
Mount Clare	MOUNT CLARE RESIDENCES E BLOCK	1	1960	603	603	RESIDENTIAL	
Mount Clare	MOUNT CLARE HOUSE	1	1772	695	695	OFFICES	
Mount Clare	PICASSO	1	1960	1,447	1,257	RESIDENTIAL	OFFICES
Whitelands	PARKSTEAD HOUSE	1	1760	9,467	9,467	TEACHING	OFFICES
Whitelands	WHITELANDS RESIDENCES (Beverley, Cheltenh	1	2005	6,267	5,794	RESIDENTIAL	
Whitelands	47 Laverstoke Gardens	1		TBC	TBC	RESIDENTIAL	
Whitelands	Redwoods Lodge 7 Alton Road	1		TBC	TBC	RESIDENTIAL	
Putney	15 Enmore Road	1		TBC	TBC	RESIDENTIAL	
TOTAL		**62**		**112,171**	**109,165**		

General notes

Please see hidden columns for comments.

Source : "GIA Report - All Buildings - 5-18-2022" from Invida work provided by Gary Munro to Manon Ray 07/07/22

Put together in this format by Manon Ray Oct 2022

APPENDIX C

	Consumption Data Amendments				
	Site	**When**	**What**	**Commentary**	**Status**
Electricity	Froebel Courts	Mar-13	Spike bigger than all previous	All actuals, no known meter issues. Leave this one as is	Leave
	(EG) - Froebel Entrance Lodge (F - Entrance Lodge)	Mar-11	Spike due to catch up invoice	Actual read in bill with 2 estimates prior. Consumption will be within the same financial year, so leave as is	Leave
	(EG) - Froebel Entrance Lodge (F - Entrance Lodge)	Jul-11	Minus figure due to actual after estimates	Actual read in bill with 2 estimates prior. Consumption will be within the same financial year, so leave as is	Leave
	(EG) - Froebel Entrance Lodge (F - Entrance Lodge)	Mar-12	Spike - no explanation	Actual read in bill , no known meter issues. Consumption will be within the same financial year, so leave as is	Leave
	(EGW) - Chadwick Halls	Jan-17	Spike - no explanation	Electric heaters used over winter due to issue with the gas. All reads are actual	Leave
	(EGW) - Downshire House	Apr-13	Post meter exchange increase	Reflect consumption from August 2013 backwards, due to incorrect install - May-13 - April-13 use this data to go alll backwards **Used consumption from Sep-13 - Aug-14 to go backwards all the way to the start**	Amend
	(EGW) - Downshire House	Apr-16	Complete increase - no explanation	Manon, do you know if there was any new equipment or more people in the property from Apri/May 16? Increase in expected due to new occupants post refurb	Leave
	(EGW) - Grove Lodge (F - Grove Lodge)	Jan-16	Consumption lower for 12 months	Ok - Intermittent occupancy	Leave
	(EGW) - Mount Clare	Oct-08	No actuals prior to this. Start read likely wrong	Use data from August 10 for a year and reflect back to the start - Check that March moving forward is close to the average **Used data from Aug-10 - Sept-11 and used this back to the start**	Amend
	(EGW) - Mount Clare	Apr-20	Spike - no explanation	All billing is to actuals, this spike is double any previous May consumption. Any ideas if there was anything that casued this Manon? Unexplained spkie agreed to retain figuere	Leave
	(EGW) - Southlands	Dec-16	Rebill to a much higher actual	All billing is to actuals, this spike is double any previous December consumption. Any ideas if there was anything that casued this Manon? Use an average of the Decembers either side (raise a recovery query) **Used the average of all Decembers other than this one, using 136604**	Amend
Gas	(EGW) - Chadwick Halls	Feb-17	Dip - But 2 consecutive actuals	All actuals, no known meter issues. Leave this one as is - Heating issue reflected in issue on Electricity	Leave
	(EGW) - Chadwick Halls	Nov-17	Dip - But consecutive actuals	All actuals, no known meter issues. Leave this one as is - Heating issue reflected in issue on Electricity	Leave
	(EGW) - Downshire House	Dec-10	Spike - But consecutive actuals	All actuals, no known meter issues. Leave this one as is - Look for an August to August financial year, look at this consumption	Leave
	(EGW) - Laverstoke Lodge	Jan-17	Spike - But consecutive actuals	Actual after an estimate. Consumption will be within the same financial year, so leave as is	Leave
	(EGW) - Whitelands Substation	Jul-11	Dip - Actual after estimates	Actual after 3 estimates. Consumption will be within the same financial year, so leave as is	Leave
	(G) - DS - Barat House	Nov-09	Spike - billed to estimates	Estimate, however actuals within the same financial year validate this bill. Leave it as is	Leave
	(G) - DS - Chapel - Newman - Howard	May-18	Minus - but consecutive actuals	All consumption was corrected in the same finanacial year. Leave it as is	Leave
	(G) - DS - Chapel flat	Dec-16	Dip - But consecutive actuals	Rebilled account, issue was corrected in the same finanacial year. Leave it as is	Leave
	(G) - DS - Duchesne	Mar-20	Spike - But consecutive actuals	All billing is to actuals, this spike is double any previous March consumption. Any ideas if there was anything that casued this Manon? - Unable to explain this spike, all actuals must consider data valid	Leave
	(G) - DS - Hirst - Harvey - Fincham	May-10	Spike - Actual after 7 estimates	Estimates go back to September so will have been within the financial year. Leave as is	Leave
	(G) - DS - Lee - Romero - Jubilee - Richardson - Bede - Digby kitchen	May-10	Spike - Actual after 10 estimates	As the estimates cross financial years, we need to spread this back over the 10 months Add the 10 estimates and actual and then divide by 11 **Added 11 estimates and 2 actual together (Jul-09- Jul-10) and then divided by the average % of the years consumption for each month, using this I picked up the dip for Jul10 for the same site**	Amend
	(G) - DS - Lee - Romero - Jubilee - Richardson - Bede - Digby kitchen	Jul-10	Dip - Actual after 1 estimate	Actual after 1 estimates. Consumption will be within the same financial year, so leave as is - As above **Added 11 estimates and 2 actual together (Jul-09- Jul-10) and then divided by the average % of the years consumption for each month, using this I picked up the dip for Jul10 for the same site**	Amend
	(G) - F - Old Court Flat	Jun-11	Zero cons to Mar-12 - All to actuals	Was there anyone on site for this period? Possibly Not occupied	Leave
	(GW) - DS - Stuart Lodge	Jan-10	Spike - consecutive estimates	As the estimates cross financial years, we need to spread this back over the period between actuals. As per Lee Remero sitre comment. Try both methids **Added 8 estimates and 1 actual together (Jul-09- May-10) and then divided by the average % of the years consumption for each month**	Amend
Water	(EGW) - Downshire House	Apr-15	3 month spike - consecutive actuals	Actual after 2 estimates. Consumption will be within the same financial year, so leave as is	Look at report that uses the nearest actual
	(EGW) - Grove Lodge (F - Grove Lodge)	Nov-18	Minus - Actual after 12 estimates	Use previous years consumption for the estimated period **Used Nov-16 to Nov-17 to replace the period of Nove-17 onwards**	Amend
	(EGW) - Mount Clare	Jul-17	Spike - but consecutive actuals	Billed to actuals, any ideas if there was anything that casued this Manon? Water Leak	Leave
	(EGW) - Whitelands Substation	Dec-10	Spike - estimates x2	Actual after 2 estimates. Consumption will be within the same financial year, so leave as is	Leave
	(GW) - DS - Stuart Lodge	Aug-13	Spike - but consecutive actuals	All actuals and for 36 m3. Leave as is	Leave
	(GW) - F - Garden Court	Aug-17	Spike - estimates x2	This needs spreading forward to September/October 17 **Added Jul-17-Oct-17 together and divided by the average % of the years consumption for each month**	Amend
	(W) - F - New and Old Court	Nov-20	Spike - consecutive estimates	Could do with a read on this to look at the entire history	??
	(W) - F - New and Old Court - Workshop	Jan-15	Spike - consecutive estimates	Previous and next are all actuals. Consumption will be within the same financial year, so leave as is	Leave

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