Energy & Carbon Report 2018/19

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2018/19 Energy Report

Contents

Executive Summary

This is the first combined report from the Energy & Carbon Team, previous reports on energy & water and carbon emissions have been separately presented and covers only UK campuses

Overall energy and water costs were £12.9 million in 2018/19, an increase of 6% from the previous year. Market energy prices rose considerably more than this and even higher costs were avoided by purchasing early in the year.

Energy consumption decreased by 4% year on year, Other fuel decreased by 6.5% and electricity was down 0.3%.with a 7% reduction in water consumption.

Carbon Dioxide Emissions from Other Fuel and Electricity, classed as Scope 1 and 2 have shown an absolute reduction of 7% or 3,345t from 2017/18 and down 24,396t from the 2009/10 baseline of 67,998t CO_2.

Floor area and student numbers were up by 1% from the previous year.

Both our energy cost per square metre and consumption per student remained below the Russell Group average.

For the avoidance of doubt, 'Energy' means Electricity & Other Fuels, unless indicated in most cases water has a separate commentary within this report. Energy Costs do not include taxes.

Headline Figures:-

Energy costs/m² up 0.05% (ave.) to £16.41
Energy consumption/m² up 0.7% to 283kWh/m^2

Energy costs/student up 4% to £326
Energy consumption/student 4.92% to 5,627kWh

Carbon emissions/m² down 8% to 60kg CO_2
Carbon emissions/student down 10% to 1,234kg CO_2

Water costs/m² down -6.26% (ave.) to £2.34
Water consumption/m² down 7.5% to 0.95m^3/m^2

Water costs/student down 5.85% to £46.42
Water consumption/student down 7.18% to 18.932m^3

External factors:-

From degree day data National database, the weather was 7% warmer in 18/19 than in 17/18

The University has published an annual report showing trends in our energy and water usage every year since 1998. With the increasing attention on carbon emissions, this report now includes data relating to the University's Carbon Management Plan (CMP).
Our emission factors and are obtained from DEFRA / BEIS
Utilities continue to be procured via Notice Ltd, which is a wholly owned subsidiary of the University of Nottingham.
[1]www.nottingham.ac.uk/sustainability

Section 1 – Energy & Water Overview

1.A. – Energy & Water Costs By Utility

Energy and Water Costs
Overall energy and water costs were £12.9 million in 2018/19, an increase of 3% from the previous year.

Our electricity costs were up 6%, gas costs up 3%, whilst water costs fell by 6%. From April 2017, our energy contracts continue with TEC (The Energy Consortium) framework on a flexible purchasing basis, this agreement has worked successfully in allowing to us to be protected against volatility in the energy markets.

COSTS				Change
	2016/17	2017/18	2018/19	17/18 to 18/19
Electricity	£7,311,262	£7,840,716	£8,301,472	6%
Other Fuel	£2,641,441	£2,916,469	£3,005,536	3%
Water	£1,642,671	£1,709,488	£1,609,554	-6%
Total	£11,595,374	£12,466,673	£12,916,562	3%

Figure 1.A.1 Table of energy and water costs for last 3 years split by Utility.

Our purchasing strategy is being constantly reviewed and regular meetings are held with TEC. The TEC Agreement is due for renewal or re-tendering in 2020.

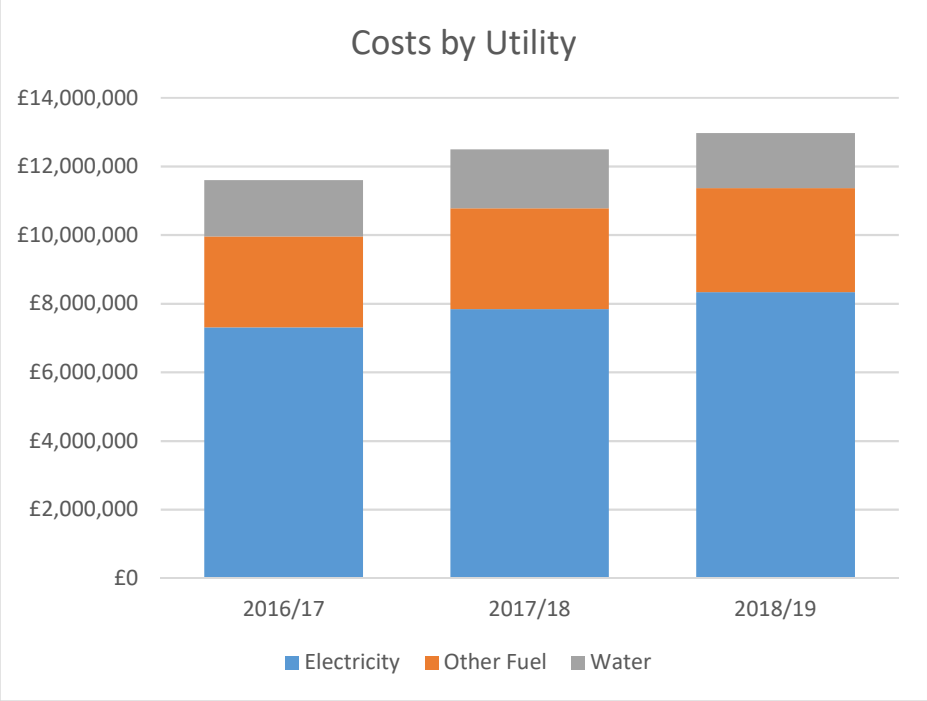


Figure 1.A.2 Graph of net energy and water costs for the last 3 years split by utility.

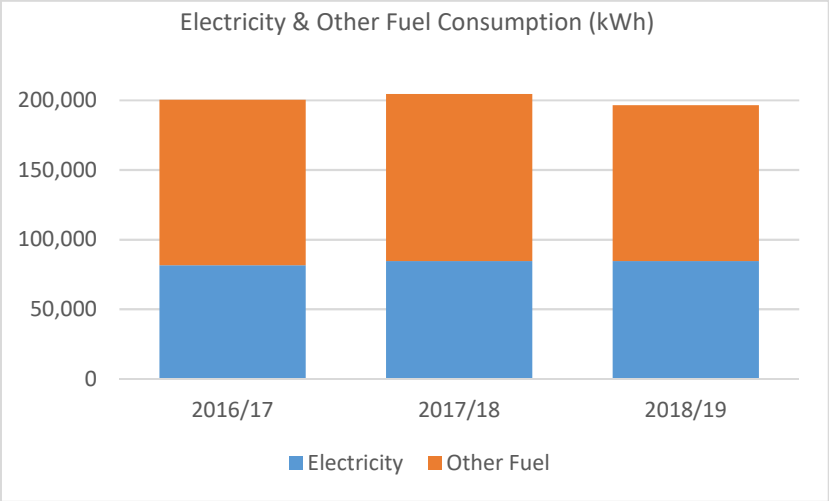
These costs can be broken down into Commodity (the cost of the electricity or gas purchased) and Non-Commodity charges (standing charges that are not negotiable) which is around a 70/30 split for electricity and a 60/40 split for gas.

Energy Consumption (MWh)

In 2018/19 there was an overall 4% reduction in consumption compared to the previous year. There has been has been no significant change in electricity consumption and a 7% reduction in Other Fuel consumption.

CONSUMPTION				Change
	2016/17	2017/18	2018/19	17/18 to 18/19
Electricity	81,474	83,270	83,035	0%
Other Fuel	118,989	119,888	112,043	-7%
Total	200,463	203,158	195,078	-4%

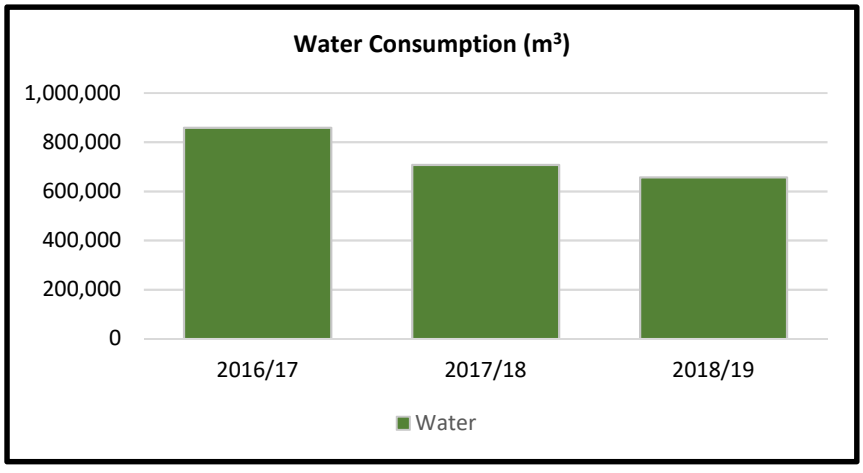
Some of the drop in Other fuel consumption is likely to be due to the weather being 7% warmer compared to degree day National database for 2017/18.



Water Consumption (m^3)

CONSUMPTION				Change
	2016/17	2017/18	2018/19	17/18 to 18/19
Water	859,124	707,123	656,375	-7%

There has been a continued reduction in water consumption, with a 7% reduction in 2018/19 from the previous year.

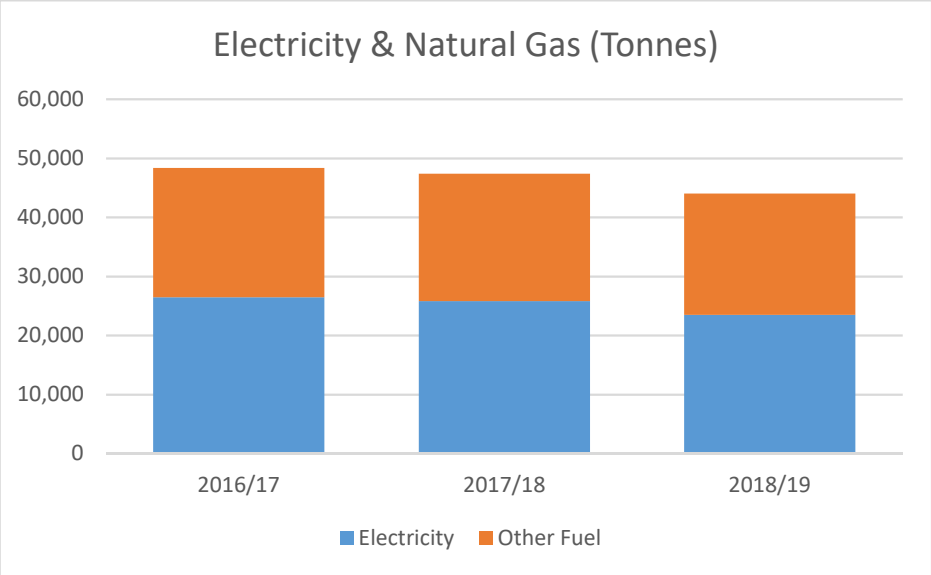


Energy Carbon Emissions (t CO_2)

In 2018/19 carbon dioxide emissions reduced by **3,345** tonnes from the previous year to a total of 43,602t CO_2.

CARBON				Change
	2016/17	2017/18	2018/19	17/18 to 18/19
Electricity	26,477	25,367	23,084	-9%
Other Fuel	21,894	21,580	20,518	-5%
Total	48,370	46,947	43,602	-7%

Some of the carbon savings reported here are as a result of a full year of operation of the investments made by the University in the summer 2018, such as upgrade of fume cupboards, ultra-low temperature freezers and replacement cooling units, boiler replacements, improved lighting and controls.



The National Grid has been increasing the proportion of renewable energy and gas fired power stations with a corresponding reduction in the use of coal fired plant to generate electricity. As a result, CO_2 emissions associated with power generation have continued to reduce. Had this emissions factor stayed the same as last year it would only equate to a 33t reduction in electricity emissions.

CO2 Emission factor	**2012/13**	**2013/14**	**2014/15**	**2015/16**	**2016/17**	**2017/18**	**2018/19**
Electricity Kg/kWh	0.484	0.494	0.462	0.412	0.352	0.311	0.278
Natural Gas Kg/kWh	0.184	0.185	0.184	0.184	0.184	0.184	0.184

1.B By Campus

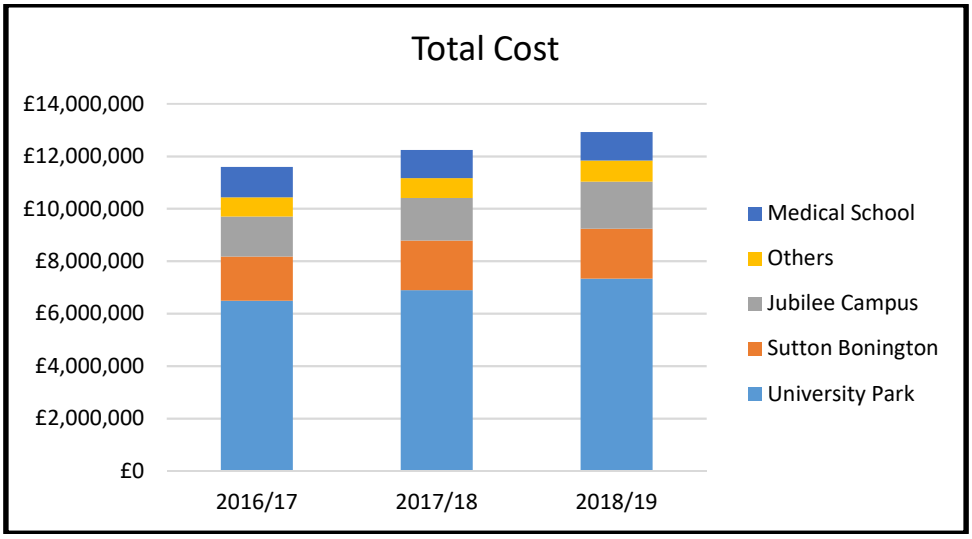
Energy & Water Costs

Overall energy costs rose by £678,247 or 6% in 18/19. Jubilee Campus shows the biggest increase, £142,121 or 80% of this increase is due to new buildings that have been fully operational for the first time during this year i.e. Advanced Manufacturing Building (AMB) and Research & Development Building (RAD).

Total					Change
		2016/17	2017/18	2018/19	17/18 to 18/19
University Park		£6,492,810	£6,900,875	£7,331,393	6%
Sutton Bonington		£1,688,096	£1,883,143	£1,906,294	1%
Jubilee Campus		£1,513,842	£1,618,464	£1,793,784	11%
Others		£733,452	£758,214	£803,194	6%
Medical School		£1,167,173	£1,077,620	£1,081,897	0%
		£11,595,373	£12,238,316	£12,916,562	6%

Figure 1.D.1 Table of energy and water costs split by campus and by utility

During 2019/20, the Bio-Discovery Institute will be operational on University Park. From 2020 onwards there are planned new buildings which will have a significant impact on energy consumption include the Power Electronics and Machine Controls building currently being constructed at Jubilee Campus and the North Lab refurbishment and Veterinary School Expansion at Sutton Bonington.



It is predicted that energy costs will continue to rise. One way of mitigating this is significant investment into on-site renewable generation. This would also have a positive effect on University goals for carbon reduction.

We monitor the energy markets relating to commodity charges to ensure best value, these make up on average around 60-70% of the invoice. It must be noted that the remaining 30-40% is made up of non-commodity charges such as transmission charges and other levies passed through to the end user to maintain and safeguard availability of supplies, these are fixed, are not affected by energy reduction and cannot be negotiated.

Energy Consumption

Energy consumption, i.e. the total of electricity and Other fuel consumed, decreased by 4% year on year. Overall most campuses have improved on their energy performance. The increase at Jubilee Campus can be attributed to the first full year energy data for the Research Accelerator Demonstrator Building and the Advanced Manufacturing Building.

		2016/17	2017/18	2018/19	17/18 to 18/19
University Park		108,663	112,648	106,401	-6%
Sutton Bonington		34,402	30,350	28,143	-7%
Jubilee Campus		21,309	21,679	21,907	1%
Others		12,806	13,590	13,497	-1%
Medical School		23,283	24,890	25,130	1%
		200,463	203,158	195,078	-4%

Figure 1.E.1 Table of energy usage for the last 3 years split by campus.

This pattern in consumption needs to continue and improve if we are to reach targets to reduce our reliance on Other fuels. A concerted directional switch to invest in, and utilise more, renewably sourced heat and power, will allow us to become leaders in developing technologies.

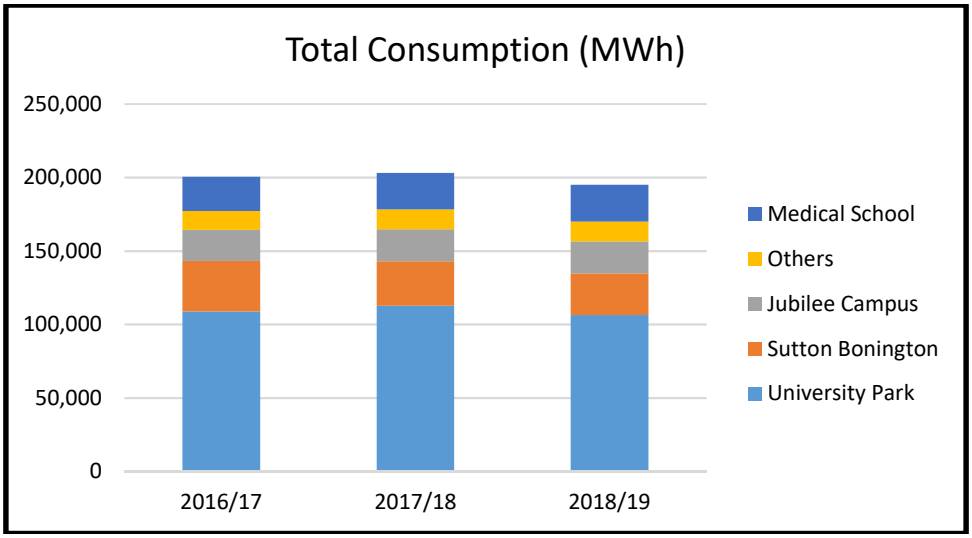


Figure 1.E.2 Graph of energy consumption for the last 3 years split by campus

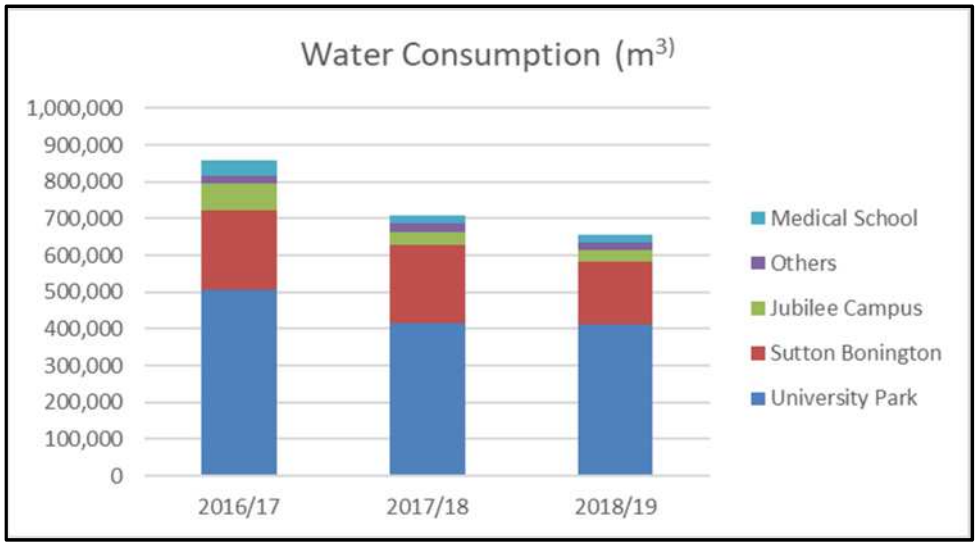
More buildings being constructed across the estate, and the requirement to support the strategic aspirations of the university, faculties, funded research, the student experience and the adoption of digital technology whilst reducing our energy requirements is challenging.

Water Consumption

Overall water consumption has improved, reducing by around 7% between 17/18 and 18/19. The 5year average consumption is 786,952m^3, current year consumption is 20% below this.

		2016/17	2017/18	2018/19	17/18 to 18/19
University Park		504,856	414,797	411,158	-1%
Sutton Bonington		217,745	213,609	170,477	-20%
Jubilee Campus		71,607	33,739	32,452	-4%
Others		22,246	23,478	20,788	-11%
Medical School		42,670	21,500	21,500	0%
		859,124	707,123	656,375	-7%

Investigations are continuing to identify where water use can be optimised or improvements can be made.



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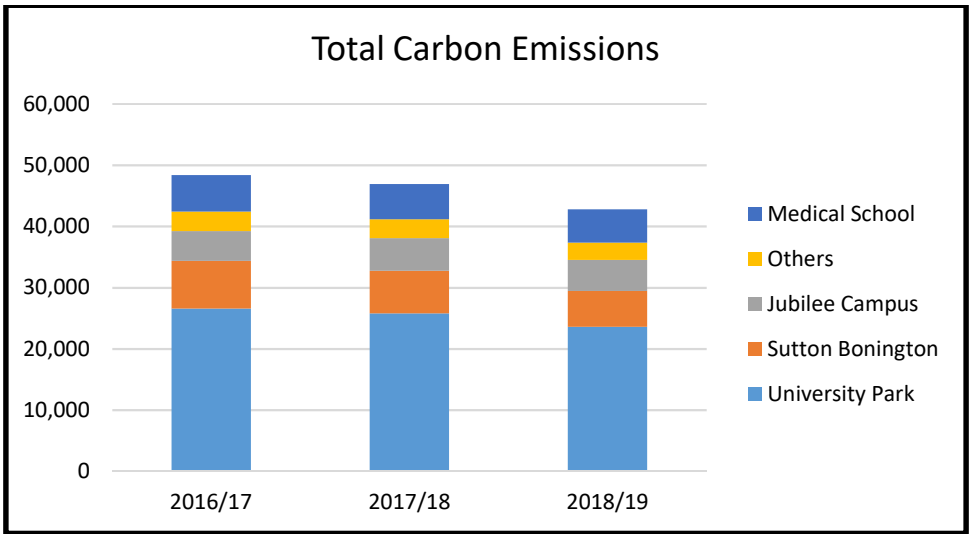
Energy Carbon Emissions

A significant amount of work has been carried out looking at the long term energy strategies of both University Park and Sutton Bonington campuses due to their energy intensive activities. At Sutton Bonington the mixed blend includes the installation of the CHP scheme, photovoltaic (PV) array. Further details and update is shown below. We will continue to focus on demand reduction, efficiency gains and low/ zero carbon energy generation.

		2016/17	2017/18	2018/19	17/18 to 18/19
University Park		26,573	25,780	24,109	-6%
Sutton Bonington		7,791	6,999	5,949	-15%
Jubilee Campus		4,877	5,294	5,170	-2%
Others		3,199	3,114	2,886	-7%
Medical School		5,930	5,760	5,487	-5%
		48,370	46,947	43,602	-7%

From investment across all campuses, our total programme savings at the end of 2018/19 stand at 14,034t CO_2 per annum from 2009/10 from completed projects.



The challenge over the next reporting period will be to continue to identify and implement carbon reduction initiatives to achieve absolute reductions in emissions in light of continued growth in new buildings and increased intensive energy consumption from research planned and as a result of new facilities.

It is clear that to achieve our long term targets we need to continue to invest in large and small scale carbon reduction projects to de-carbonise our power and heating needs. However, as the National Grid continues to reduce reliance on Other fuels for electricity production, our challenge will be to reduce demand for heat and de-carbonise the heat supply to our buildings which is currently predominately from the combustion of natural gas.

1.C By Campus & Utility

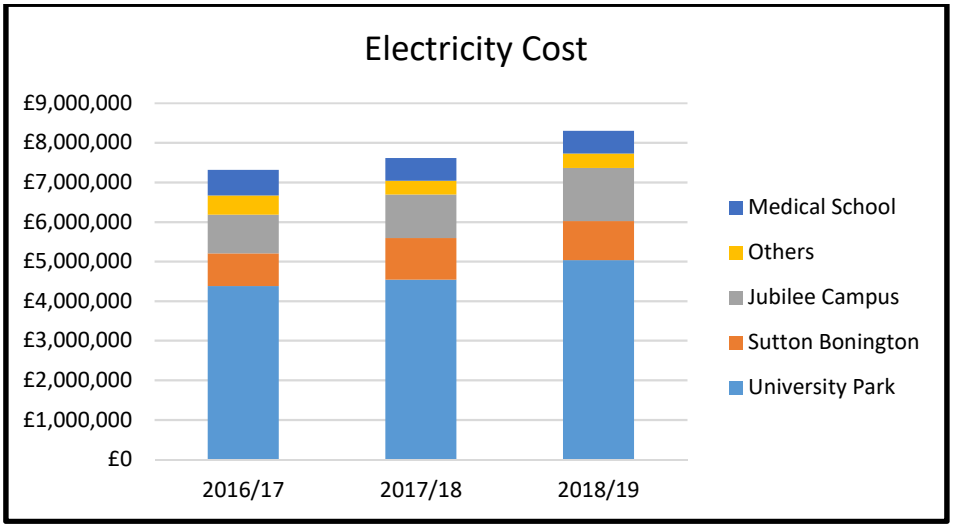
Energy Cost

Electricity

Prices have risen by 6% in 18/19 subsequently costs have risen at most campuses, because consumption has been slightly lower, around £23,000 in costs have been avoided.

		2016/17	2017/18	2018/19	17/18 to 18/19
University Park		£4,382,301	£4,540,180	£5,032,929	11%
Sutton Bonington		£822,746	£1,054,200	£989,807	-6%
Jubilee Campus		£979,819	£1,096,053	£1,337,065	22%
Others		£487,222	£346,306	£371,248	7%
Medical School		£639,173	£575,620	£570,423	-1%
Total		£7,311,262	£7,840,716	£8,301,472	5.9%

Additionally at Sutton Bonington, some of these costs have been avoided by better and increased use of the CHP, improvements were made to the controls software to increase run hours and generate more electricity than last year as identified in Section 2b of this report.



Increases at the Jubilee Campus can in part be attributed to the Advanced Manufacturing Building and the Research Accelerator Demonstrator building being fully operational 2018/19.

In order to maintain business continuity and ensure resilience of our high voltage electricity networks at University Park and Sutton Bonington we are increasing our Authorised Supply Capacity (ASC) and investing circa £2m in reinforcing the HV infrastructure.

It is expected to add a minimum of £55,000 to University annual electricity spend.

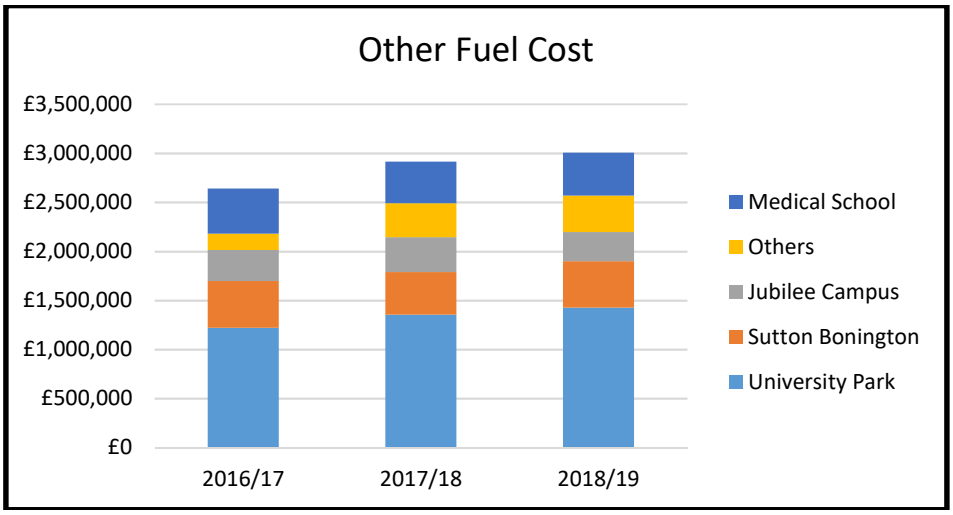
Further assessment of all other supplies has found them all to be within limits.

Other Fuel

Other fuel unit prices have risen on average by 10%. Milder weather has meant that we have used less, so costs of an estimated £200,000 have been avoided.

		2016/17	2017/18	2018/19	17/18 to 18/19
University Park		£1,220,509	£1,354,736	£1,426,208	5%
Sutton Bonington		£479,328	£435,772	£473,217	9%
Jubilee Campus		£314,780	£353,655	£299,389	-15%
Others		£166,824	£346,306	£371,248	7%
Medical School		£460,000	£426,000	£435,474	2%
		£2,641,441	£2,916,469	£3,005,536	3.1%

The large variance at Jubilee Campus is due to a reduction in consumption at GSK. As unit prices and standing charges continue to rise, we need to expand our use of alternative fuels and heat sources.

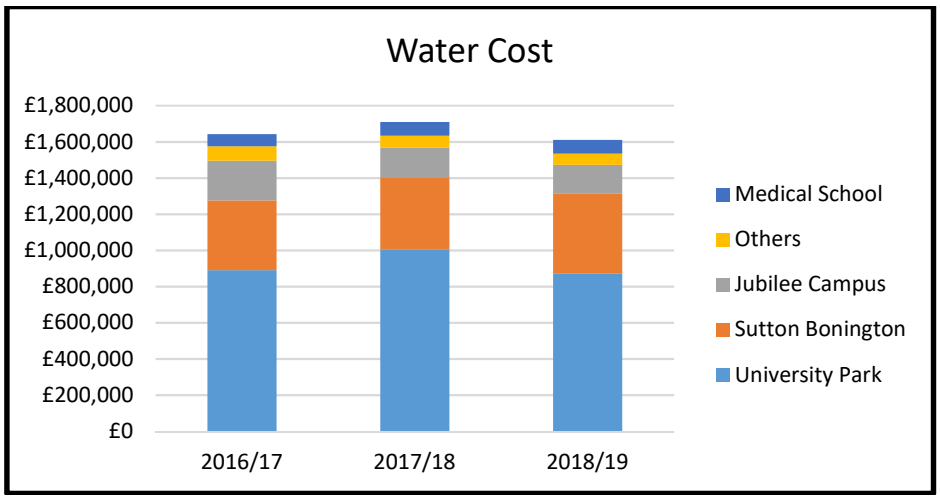


Water

Water use has continued to decrease, although problems with ageing infrastructure and leaks at Sutton Bonington has kept the consumption higher for the campus. Extensive works have been carried out to replace pipeline and repair leaks and it is expected that consumption at Sutton Bonington will now start to reduce.

		2016/17	2017/18	2018/19	17/18 to 18/19
University Park		£890,000	£1,005,959	£872,256	-13%
Sutton Bonington		£386,022	£393,171	£443,270	13%
Jubilee Campus		£219,243	£168,756	£157,330	-7%
Others		£79,406	£65,602	£60,698	-7%
Medical School		£68,000	£76,000	£76,000	0%
		£1,642,671	£1,709,488	£1,609,554	-6%

A faulty meter and leak was detected at Jubilee Campus, the meter was subsequently replaced and the leak was located and repairs are ongoing.



Energy Consumption

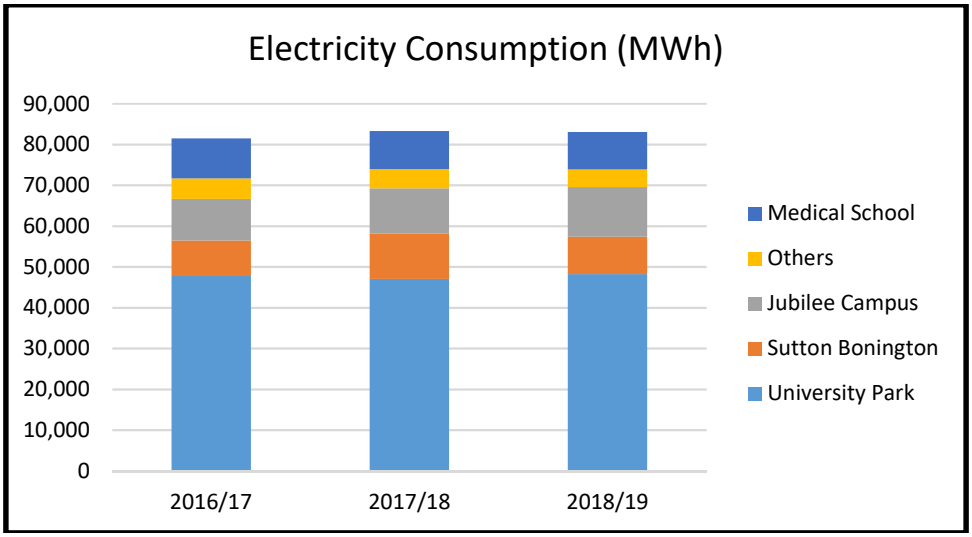
Electricity MWh

Electricity consumption across the University has reduced although a small increase at University Park is in part to due to the New Cripps Health Centre, which uses electric heating with ground sourced heat pumps.

The increase at the Jubilee Campus is linked to the full operation of 2 new buildings, AMB and RAD.

		2016/17	2017/18	2018/19	17/18 to 18/19
University Park		47,738	47,015	48,208	3%
Sutton Bonington		8,699	11,176	9,183	-18%
Jubilee Campus		10,223	11,056	12,175	10%
Others		5,015	4,733	4,286	-9%
Medical School		9,799	9,290	9,183	-1%
		81,474	83,270	83,035	-0.3%

The large decrease at Sutton Bonington in imported electricity is due to improvements made and availability of the combined heat and power (CHP) which generates electricity for the campus.

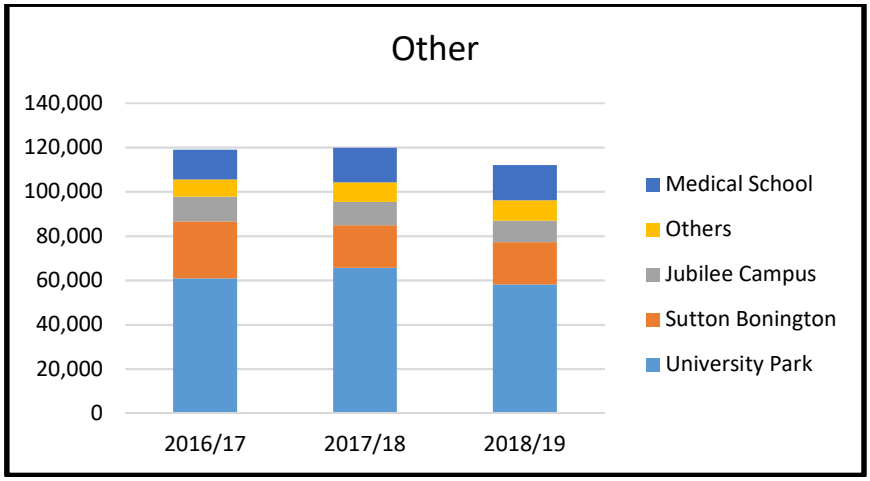


Other Fuel MWh

The warmer weather in 2018/19 compared to 17/18 has reduced the need for gas fired heating plant to operate, so Other fuel consumption has been reduced.

		2016/17	2017/18	2018/19	17/18 to 18/19
University Park		60,925	65,634	58,193	-11%
Sutton Bonington		25,703	19,174	18,961	-1%
Jubilee Campus		11,086	10,623	9,732	-8%
Others		7,791	8,857	9,211	4%
Medical School		13,484	15,600	15,947	2%
		118,989	119,888	112,043	-6.5%

Regular in depth monitoring of energy invoices identified that there were mains incoming gas meters at University Park & Jubilee Campus which were malfunctioning, an estimated 2MWh consumption has not been accounted for, if this were included above then the reduction in consumption would be -5%.

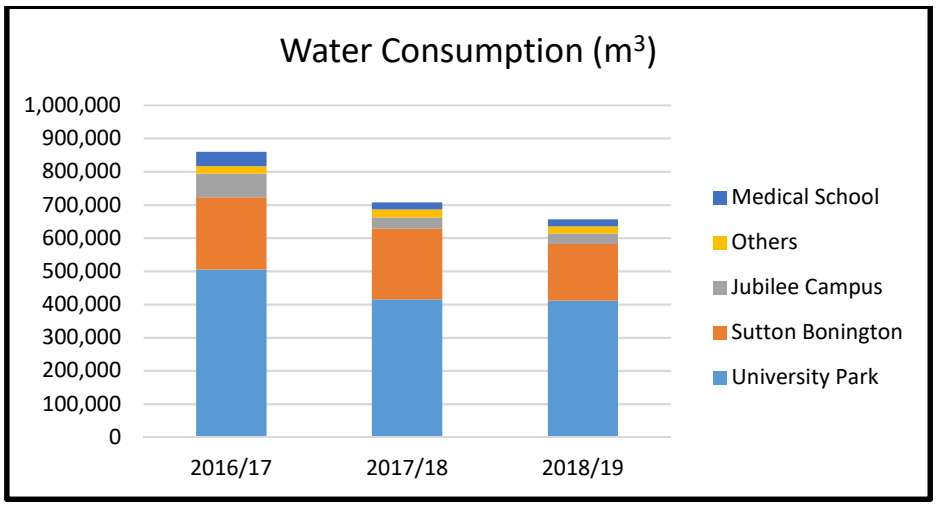


Water m³

Overall the efficiency of our water consumption per m2 has improved and work continues to identify leakage and reduce wastage. Significant improvements have been achieved at Sutton Bonington, in part due to the significant investment in water mains through the campus over the past 24 months.

		2016/17	2017/18	2018/19	17/18 to 18/19
University Park		504,856	414,797	411,158	-1%
Sutton Bonington		217,745	213,609	170,477	-20%
Jubilee Campus		71,607	33,739	32,452	-4%
Others		22,246	23,478	20,788	-11%
Medical School		42,670	21,500	21,500	0%
		859,124	707,123	656,375	-7%

Please note the Medical School data is estimated. Work is underway to improve the data at the Medical School in collaboration with Severn Trent and the Nottingham University Hospitals Trust.



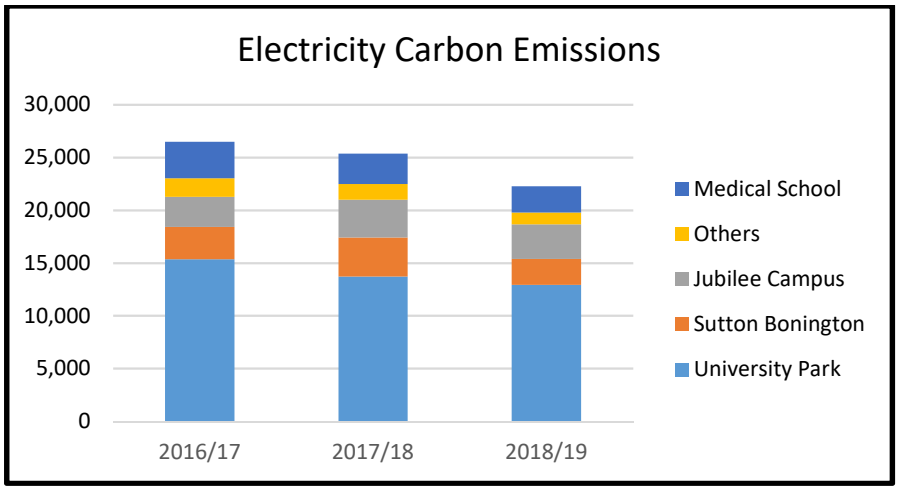
Energy Carbon Emission (Tonnes CO_2)

Electricity

At Sutton Bonington the problems encountered during 2017/18 with the CHP have been remedied in 2018/19 and has significantly improved performance and increased operating hours.

		2016/17	2017/18	2018/19	17/18 to 18/19
University Park		15,363	13,704	13,402	-2%
Sutton Bonington		3,062	3,711	2,553	-31%
Jubilee Campus		2,837	3,579	3,385	-5%
Others		1,765	1,484	1,191	-20%
Medical School		3,449	2,889	2,553	-12%
		26,477	25,367	23,084	-9.0%

A combination of a reduction in consumption and a decreased emissions factor for grid electricity is reflected in the figures above.

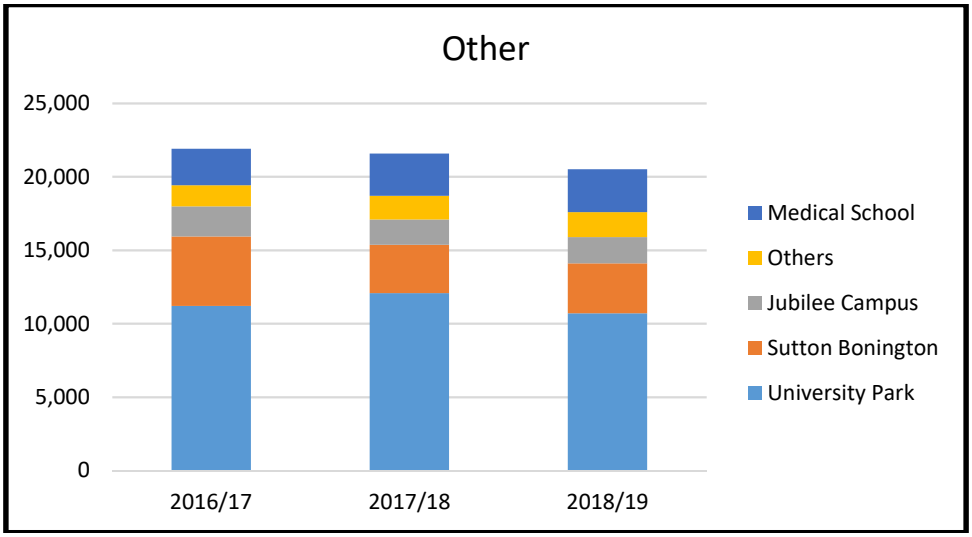


Other Fuel

A combination of increasing CHP operating hours at Sutton Bonington and King's Meadow Campus, plus more demand from new buildings at Jubilee has resulted in increases at these locations. The overall reduction of 4.9% is a result of the milder weather throughout the year.

		2016/17	2017/18	2018/19	17/18 to 18/19
University Park		11,210	12,077	10,707	-11%
Sutton Bonington		4,729	3,288	3,396	3%
Jubilee Campus		2,040	1,715	1,786	4%
Others		1,434	1,630	1,695	4%
Medical School		2,481	2,870	2,934	2%
		21,894	21,580	20,518	-4.9%

Investigation will continue into projects which will reduce our Other fuel consumption through use of alternative energy sources.



1.D By Floor Area

There was a relatively small increase in floor area in 2018/19 with the addition of the Cripps Health Centre to the portfolio. The building adds 3,142m² to University Park, meaning total floor area has increased by 0.45%.

M²	2016/17	2017/18	2018/19	
University Park	347,808	354,090	357,232	1%
Sutton Bonington	77,293	77,293	77,293	0%
Jubilee Campus	95,601	106,981	106,981	0%
Others	69,880	69,880	69,800	0%
Medical School	77,644	77,644	77,644	0%
	668,226	685,888	688,950	0.45%

During 2018/19, the new building as part of the Bio-Discovery Institute has been constructed and will be fully operational late 2019/20 on University Park. From 2020 onwards, planned new buildings which will have a significant impact on energy consumption include the Power Electronics and Machine Centre which is currently in construction at Jubilee Campus and the North Labs and Veterinary School Expansion at Sutton Bonington.

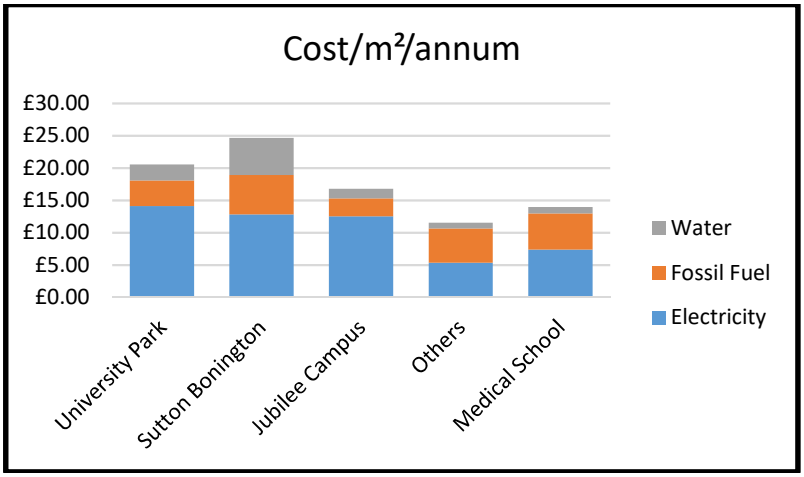
Costs

Average floor area energy costs have increased compared to last year, this reflects rising energy prices.

		Cost/m²/annum				Difference to last year	
	Floor Area	Electricity	Heating	Water	Total		%
University Park	357,232	£14.09	£3.99	£2.44	£20.52	£1.54	8.13%
Sutton Bonington	77,293	£12.81	£6.12	£5.73	£24.66	£0.25	1.04%
Jubilee Campus	106,981	£12.50	£2.80	£1.47	£16.77	£0.32	1.93%
Others	69,800	£5.32	£5.32	£0.87	£11.51	£0.73	6.74%
Medical School	77,644	£7.35	£5.61	£0.98	£13.93	£0.05	0.39%
Total	688,950						3.65%

Figure 1.B.1 Table of energy costs per square metre, split by campus.

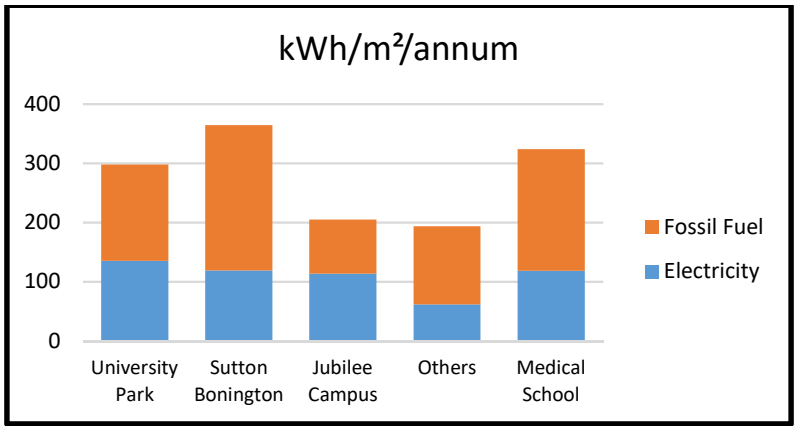
University Park has the largest increase, some of which can be attributed to the new Cripps Health Centre and Beeston Hall.



Consumption
Overall there has been an improvement in consumption by floor area.

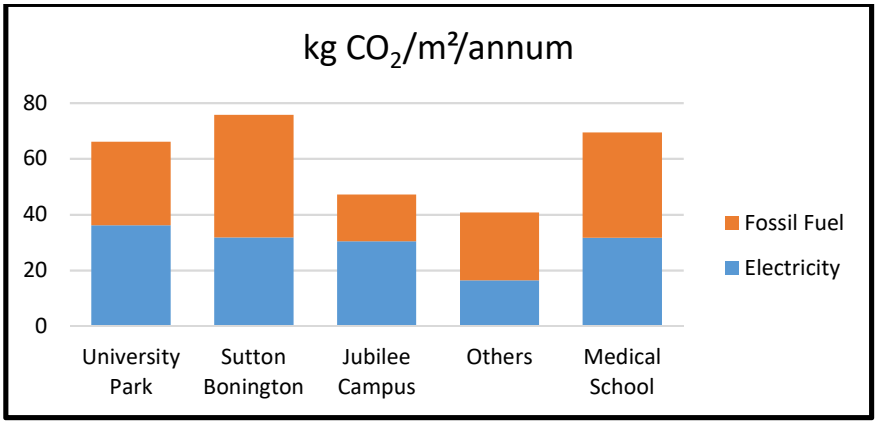
		Consumption (kWh)/m²/annum				Difference	
	Floor Area	Electricity	Fossil Fuel	Total	Last Year	to last year	%
University Park	357,232	135	163	298	315	-17.49	-5.55%
Sutton Bonington	77,293	119	245	364	393	-28.55	-7.27%
Jubilee Campus	106,981	114	91	205	203	2.13	1.05%
Others	69,800	61	132	193	195	-1.33	-0.68%
Medical School	77,644	118	205	324	321	3.08	0.96%
Total	688,950	121	163	283	285		

Improvement can be seen in energy consumption per m², for both University Park and Sutton Bonington, with only a small increase at Jubilee Campus.



Emissions

		Emissions (kg CO_2)/m²/annum		
	Floor Area	Electricity	Heating	Total
University Park	357,232	36	30	66
Sutton Bonington	77,293	32	44	76
Jubilee Campus	106,981	30	17	47
Others	69,800	16	24	41
Medical School	77,644	32	38	69
Total	688,950			60



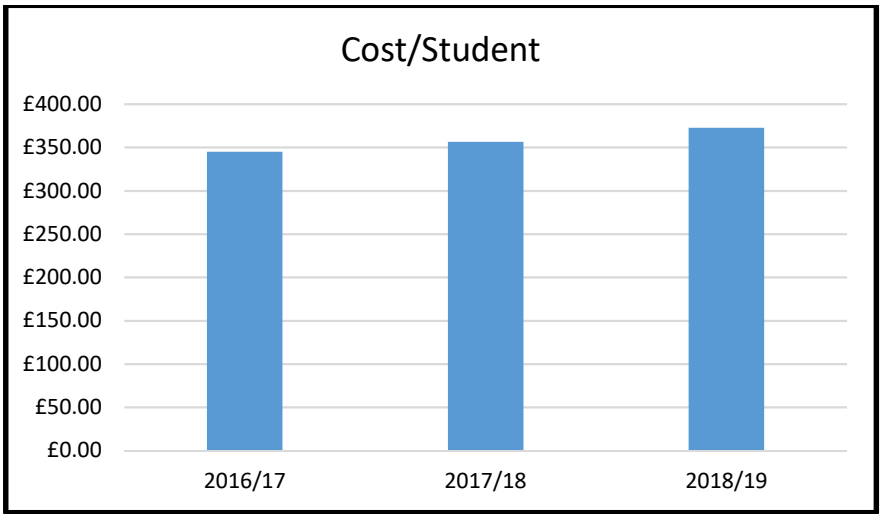
1.E By Student

Student numbers were slightly up on last year but have not varied very much.

Costs

The rising cost of energy and water has increased cost per student by 4.5%

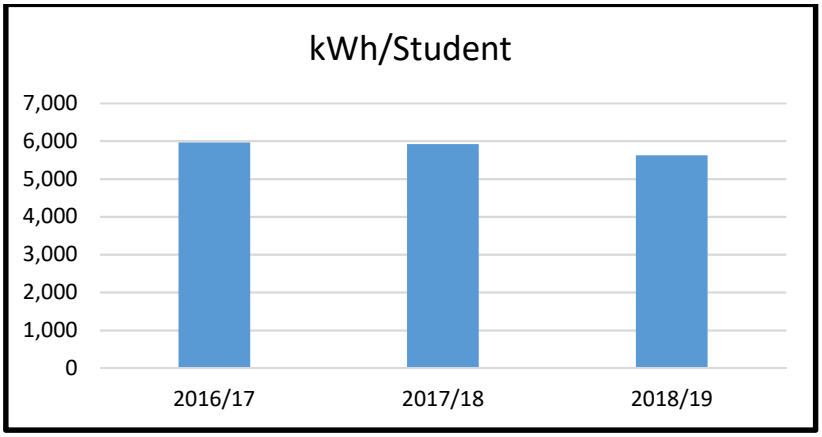
	2016/17	2017/18	2018/19	Change
UK Student Numbers	33620	34329	34670	0.99%
Energy & Water Costs	£11,595,373	£12,238,316	£12,916,562	5.54%
Cost/Student	£344.90	£356.50	£372.56	4.50%



Consumption

With energy consumption reducing, kWh/student has dropped by 4.92%

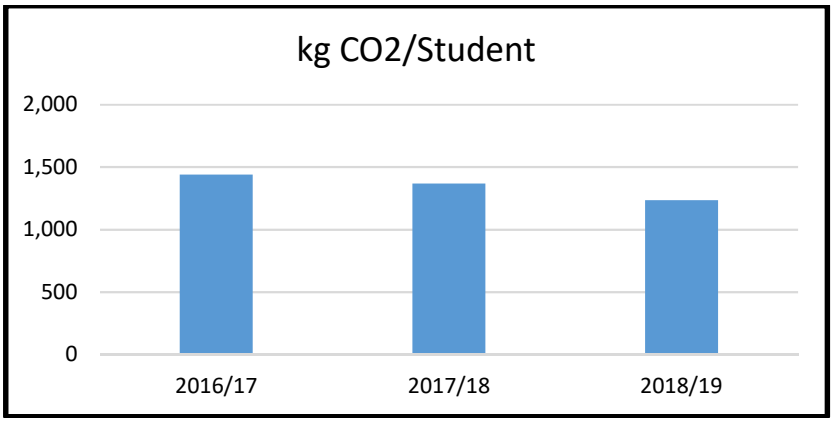
	2016/17	2017/18	2018/19	Change
UK Student Numbers	33620	34329	34670	0.99%
Energy Consumption	200,463	203,158	195,078	-3.98%
kWh/Student	5,963	5,918	5,627	-4.92%



Student numbers quoted - https://www.nottingham.ac.uk/ppsc/spp/student-statistics/student-statistics-2018-19.aspx

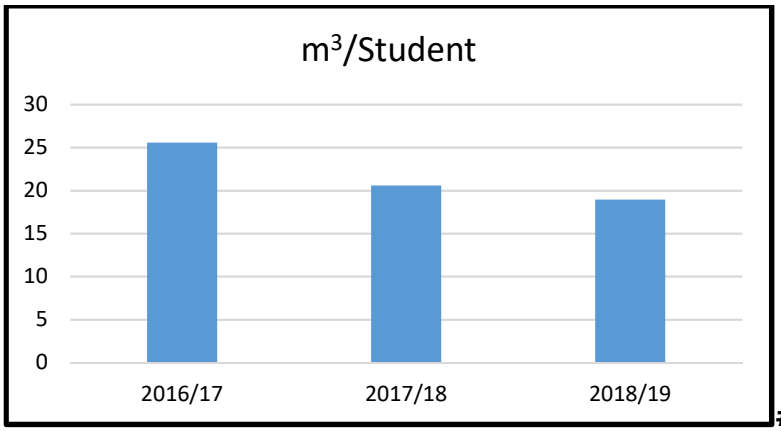
Emissions

	2016/17	2017/18	2018/19	Change
UK Student Numbers	33620	34329	34670	0.99%
Energy Emissions	48,370	46,947	43,602	-7.12%
kg CO_2/Student	1,439	1,368	1,258	-8.04%



Water Consumption

	2016/17	2017/18	2018/19	
UK Student Numbers	33620	34329	34670	0.99%
Water Consumption	859,124	707,123	656,375	-7.18%
m^3/Student	26	21	19	-8.09%



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Section 2– Renewable Energy

2.A Generation

Most of our renewable installations had a fall in productivity in 2018/19. Total generation dropped by 34%, some of this is due to systems not being operational and some can be linked to weather. More detailed information is shown in 2.B below.

Building	Type	Annual Generation (kWh) 18/19	Annual Generation (kWh) 17/18	
BioEnergy	Biomass	90,980	45,840	98.47%
Geospatial	Biomass	53,290	62,200	-14.32%
Total		144,270	108,040	33.53%
Humanities	GSHP	85,800	260,700	-67.09%
Si Yuan	GSHP	46,058	52,880	-12.90%
Cripps Health Centre (New 2019)	GSHP	43,600		
ATC	GSHP	38,850	39,010	-0.41%
Maths Building	GSHP	9,660	12,261	-21.21%
Total		223,968	364,851	-38.61%
Sherwood & Rutland	Solar Thermal	9,486	8,942	6.08%
Si Yuan Chinese Studies	Solar Thermal	780	1,723	-54.73%
Total		10,266	10,665	-3.74%
Sustainable Chemistry (GSK)	PV	215,973	214,389	0.74%
Veterinary School	PV	123,909	124,743	-0.67%
Derby Hall	PV	48,985	49,195	-0.43%
Lincoln Hall	PV	37,639	38,424	-2.04%
George Green Library	PV	32,684	33,094	-1.24%
Business Sch North	PV	14,245	14,283	-0.27%
Energy Technologies Building	PV	13,511	11,132	21.37%
Aerospace Technology	PV	11,212	11,453	-2.10%
Orchard Hotel	PV	8,621	7,485	15.18%
Dearing	PV	7,310	6,801	7.48%
Computer Sciences	PV	6,706	6,954	-3.57%
Advanced Manufacturing (New 2018)	PV	4,877	3,164	54.14%
Ingenuity Centre (TEC)	PV	4,511	4,551	-0.88%
Si Yuan Chinese Studies	PV	4,122	4,677	-11.87%
Total		534,305	530,345	0.75%
IMH	ASHP	5,110	7,220	-29.22%
Total		5,110	7,220	-29.22%
Total Renewable		917,919	1,021,121	-10.11%

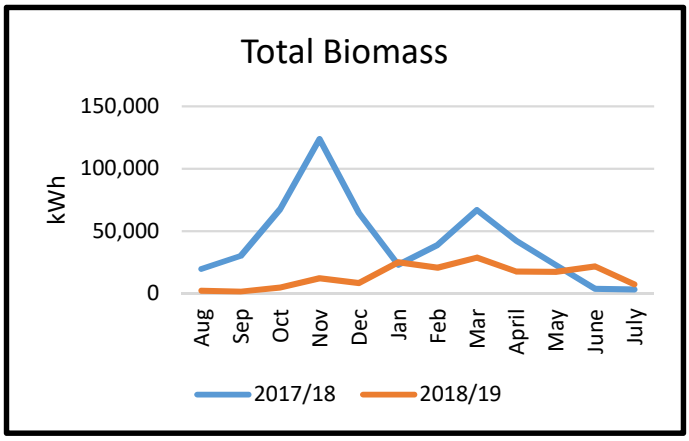
There are several installations that are currently not being monitored so a project is being drawn up to look at getting the additional metering installed to allow us to fully record our renewable generation across campuses.

There is increasing interest in expanding our renewable portfolio, as we look towards carbon neutrality. Feasibility studies are being carried out for a 2MW PV array at Sutton Bonington.

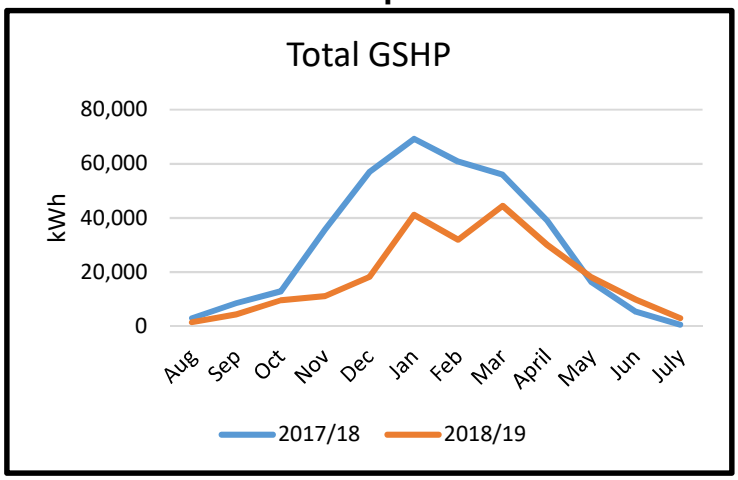
2.B Production and Performance

Biomass Boilers
Problems were encountered over 18/19, with fuel and reliability problems throughout the installations. Significant works from the Operational team and contractors have resolved these.

Total Annual production: 169,550 kWh.



Ground Source Heat Pumps



All GSHP's operated correctly during 18/19.

There has been an increase in generating capacity with the addition of Cripps Health Centre.

Total Annual generation: 223,968 kWh.

Solar thermal
The Solar thermal installations at Sherwood & Rutland and Si Yuan operated throughout 2018/19

There was a decrease of 17% in annual output, due to poorer weather conditions.

Total Annual generation: 10,266 kWh

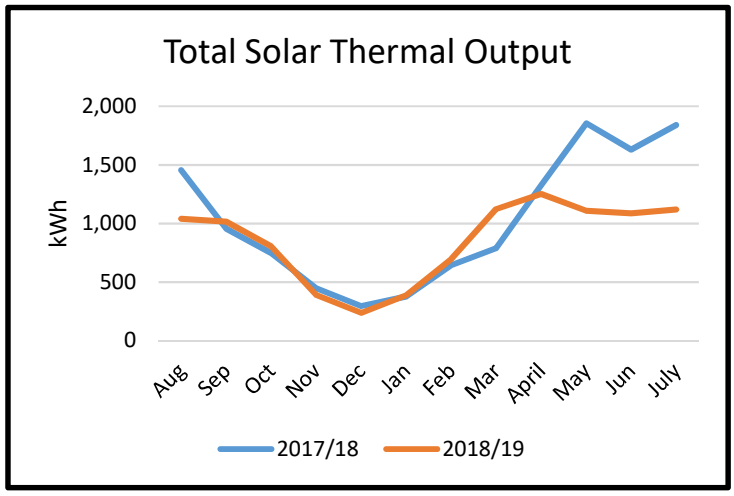
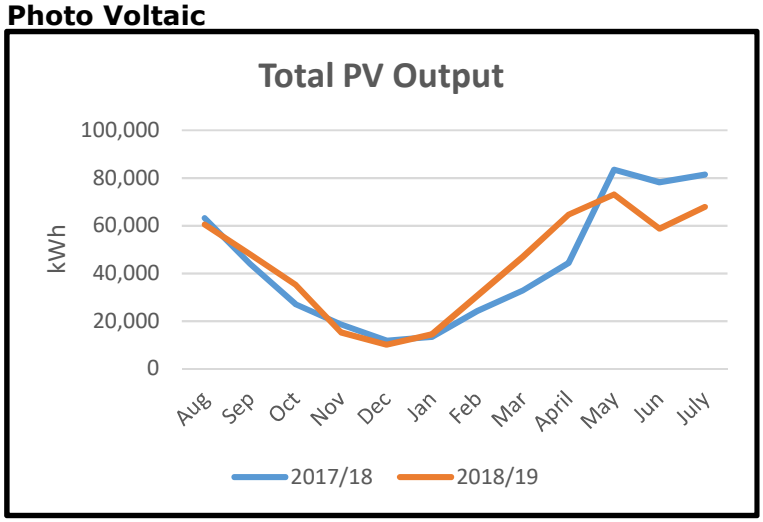


Photo Voltaic



average manufacturers data for solar PV is 72 x 152mm x 152mm arrays

All 14 PV installations totalling 3,922 panels covering an approx. area of 6,500m² have been operating throughout the year

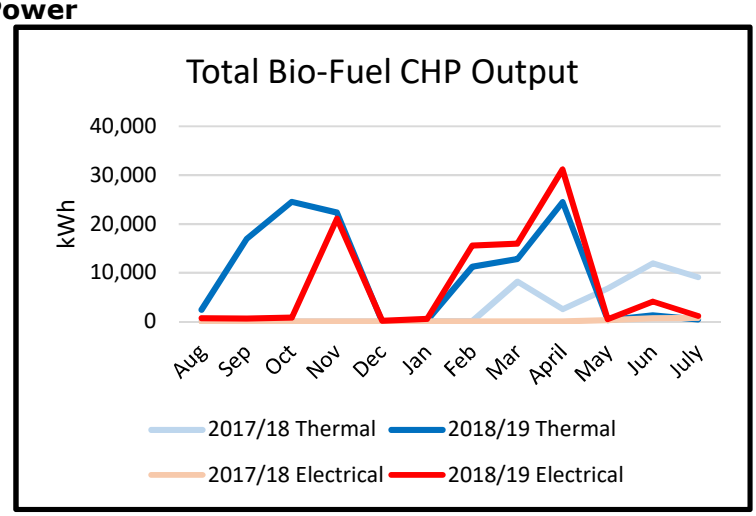
Generation equalled that of 2017/18.

Total Annual generation: 534,339 kWh.

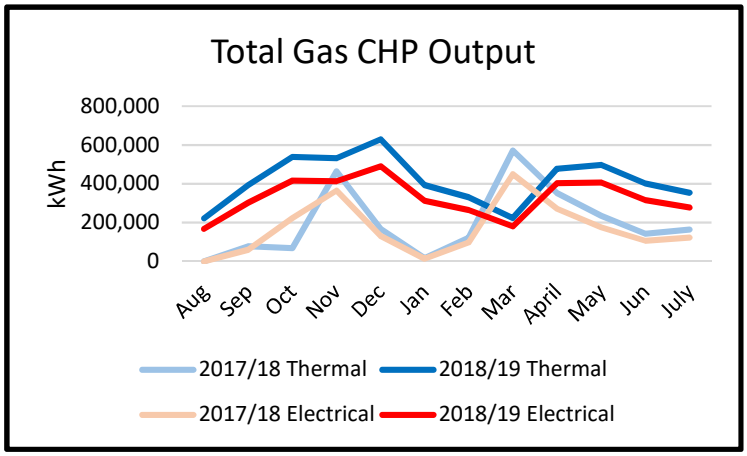
Biofuel Combined Heat & Power

The biofuel CHPs at Sustainable Chemistry and Energy Technologies Building have had increased availability throughout the year as Operational teams and contractors work hard to ensure correct running.

Total Annual generation:
Electricity 92,626 kWh.
Thermal 117,190 kWh.



Natural Gas Combined Heat & Power



The Sutton Bonington CHP was operational throughout the year

Improvements to the BMS software have been made to increase run hours.

Total Annual generation:
Electricity 3,953,289 kWh
Thermal 4,997,929 kWh.

Section 3 – Carbon Management Plan

This is the ninth year of reporting on our Carbon Management Plan (CMP), it provides details on progress achieved and performance improvements made against targets.

The CMP was originally approved in December 2010 and was updated in 2016. So far the CMP has resulted in investments in excess of £18.8m, with estimated annual savings of 14,034 tonnes of CO_2. The report provides an update on energy and carbon dioxide (CO2) emissions arising from Scope 1 and 2 sources, CO_2 reduction projects approved and installed, CO_2 savings, financial performance and the programmes of work planned for the next 12 months.

Main areas of investment to be centred on:
1. Improvements in energy efficiency of buildings, including insulation, heating & lighting
2. More efficient use of existing equipment
3. Generation of energy from small/medium scale renewable energy systems
4. Major infrastructure upgrades to replace existing plant to reduce energy cost, carbon emissions while at the same time improving system resilience.

The programme includes a number of specific investment projects and more generic programmes to deliver CO_2 reductions. These focus on the areas of energy saving and energy efficiency for Scope 1 (predominantly gas combustion in boilers) and Scope 2 (electricity use) emissions.

The CMP provided a baseline of CO_2 emissions; sets emission reduction targets; and mapped out a 5 year investment programme implemented to deliver environmental performance improvements and carbon & financial savings[1]. The CMP targets and objectives set in the 2010 CMP are:

	Baseline 2009/10	Target 2014/15	Target 2020
Total CO_2 emissions p.a.	68,000 tonnes	54,000 tonnes	41,000

These represented reductions from the 2009/10 of 20% on CO_2 emissions by 2014/15.

We will continue to prioritise the most energy and carbon intensive buildings and achieve a better understanding of what contributes to our significant 'out of hours' baseload. Continued development of energy strategies for each campus with the overall aim of reducing carbon emissions, improving financial sustainability, system resilience and student experience and where possible, deliver income generation.

3.A Future Energy/Carbon Projects

Large scale Renewable energy schemes
Initially, a detailed business case for a 1MWe PV array located on land at Sutton Bonington was submitted. This was put on hold but is now to be resubmitted as a 2MW array and has potential to achieve annual fuel cost savings of £157,000 and a carbon saving of around 620t CO_2. Over the 25 year life of the panels the system is expected to save around £6m in electricity cost and over 6625 t CO_2.

Combined with the existing CHP plant, on certain days of the year the campus could be self-sufficient in electrical power. CHP and solar PV have a good output synergy as PV provides power peak around the middle of the day/ early afternoon when heating

[1] www.nottingham.ac.uk/about/documents/carbonmanagementplan2011.pdf

demand reduces and the CHP usually reduces output as heating demands are met, hence maintaining a good electrical generation balance for the site. There are other location studies underway including land adjacent to the River Trent which could be used for significant PV generation (around the 5MW output) The scheme could be expanded to include wind turbine power generation, subject to possible relaxation of planning constraints following the city council recent announcement of their 2028 neutrality target.

University Park Low Carbon heat networks

Development of a low carbon energy centre to be located in the former CHP building behind the boiler house (adjacent to the Life Sciences building) could achieve significant fuel cost savings and reduction in CO_2. It was proposed that this £3.5m scheme will utilise gas-fired CHP plant with aim of reducing energy costs, carbon emissions while at the same time improving overall system resilience of the district heating system that serves around 20 buildings across University Park.

The project development has led to a reappraisal of all other options including full decentralisation with installation of gas fired boiler plant to individual buildings. The outcome of this appraisal shows that the scheme is no longer viable as a means of reducing our carbon emissions due to the significant consumption of natural gas used by this type of cogeneration plant. At this stage the recommendation is to develop of a number of smaller heat networks typically 3 or 4 serving a number of local buildings, with a few of the more distant namely Trent building, Sir Clive Granger and Portland building having standalone boiler plant.

This would enable the systems to operate at much lower temperatures resulting in greater efficiency while still retaining the option of 'bolt on' future technologies to achieve further significant energy and carbon savings. This could involve multi stage high temperature heat pumps that could in theory use only a third of the energy of this proposal and cut CO2 emissions by a further 50%.

University Park Electrical loads

We have continued with ongoing monitoring to understand where the significant overnight baseloads are located and how these may be reduced. The loads are quite diverse across the campus with no particular high density energy use located with the exception of specialist research equipment. As would be expected this is located in the Science and Engineering faculties which account for almost 40% of total electrical use mainly due to equipment/ processes that operate year round. Further understanding is still required and schools and departments have been asked to submit equipment schedules detailing power rating and likely operating profiles. Demand reduction will continue to be an area of focus in 19/20.

3.B Future carbon management and investment programmes

A refreshed and updated CMP is due in 2020 to reflect the University strategy commitments and will continue to deliver the depth and range of carbon projects needed to deliver our institutional targets. This includes continuing with plant replacement, glazing and insulation projects and at the same time continue on site with major investments such as University Park low carbon heat clusters and the Sutton Bonington large scale PV Array. An energy strategy to cover the expansion of Jubilee Campus is being developed to look at options for low carbon energy sources to serve a number of buildings at the north end of the campus from a common plant room. Whilst there is likely to be significant further development on acquired sites the

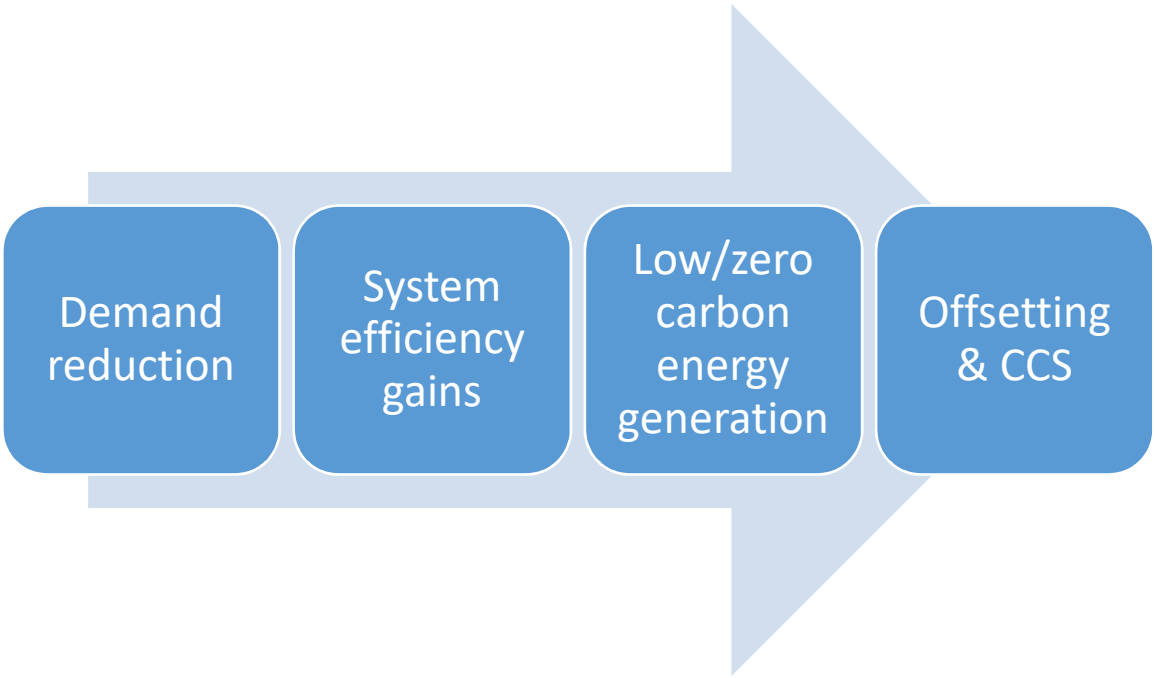
appraisal assumed the development of the 'bonded warehouse' site whilst the future plans of that site are considered.

As the University develops its wider strategy and an estate development framework we will identify where investment is needed over the next 10 years to reduce carbon emissions. These are likely to include large scale building fabric upgrades as part of major general refurbishment works to our halls of residence as well as investment in the underpinning heat and power infrastructure.

The programme continues the focus on investment in the CMP's core activities:

- Large scale Plant/ infrastructure replacements
- Laboratory fume cupboard efficiency upgrades
- System efficiency improvements, e.g. boilers, chillers, lighting, motors & drives
- Large scale low carbon generation strategies
- Staff and student engagement
- Continued improvements to existing building fabric to reduce heat losses

To achieve carbon neutrality it is very likely we will have to develop a scheme of carbon offsetting and/or Carbon Capture and Storage (CCS) as and when the technology becomes commercially available. The pathway would become:-



Section 4 – Taxes and VAT

4.A - Climate Change Levy (CCL) and VAT

VAT costs paid by Notice Ltd on energy bills increased by 5% to £2.26 million in 2018/19, and CCL also increased to £544,988 (6%).

The Climate Change Levy (CCL) is a tax on energy consumption that was introduced in April 2001. On April 1st 2019 the rates rose 67% to 0.339p/kWh on gas and 45% to 0.847p/kWh on electricity.

If the taxes were included in the total expenditure on utilities the totals can be seen below:-

Taxes & VAT						%
	Electricity	Fossil Fuels	Water	Totals	2017/18	Diff
Utility Costs	£ 8,301,472	£ 3,005,536	£ 1,609,554	£ 12,916,562	£ 12,466,773	4%
Climate Change Levy	£ 483,976	£ 61,012		£ 544,988	£ 516,324	6%
Value Added Tax	£ 1,660,294	£ 601,107		£ 2,261,402	£ 2,151,457	5%
	£ 10,445,743	**£ 3,667,655**	**£ 1,609,554**	**£ 15,722,952**	**£ 15,134,553**	**4%**

Figure 1.C.1 Table of energy and water costs including Climate Change Levy and Value Added Tax.

4.B – The Carbon Reduction Commitment Energy Efficiency Scheme

Costs from the CRC Energy Efficiency Scheme are not included in the other figures in this report, because the scheme operates on an April to March year, costs are not levied on utility bills, and the Scheme operates on a slightly different subset of properties. However, the results of the seventh full year of the scheme (April 2018 to March 2019) are listed below.

Under the Scheme, our emissions were reported as 41,457 Tonnes of CO_2 (down 16.0% from 49,420 in the previous year).

Note that the cost of 41,457 allowances (£92,927.40).

This is the final year for CRC declarations.

Section 5 – Russell Group Comparison

5.A – Energy Costs Comparison

The statistics in the next four tables provide a range of comparators to other research intensive universities, as reported in the HESA Estate Management Return for 2017/18. Note that this is the most recent year where data is available for comparison, but runs one year behind the other information presented in this report.

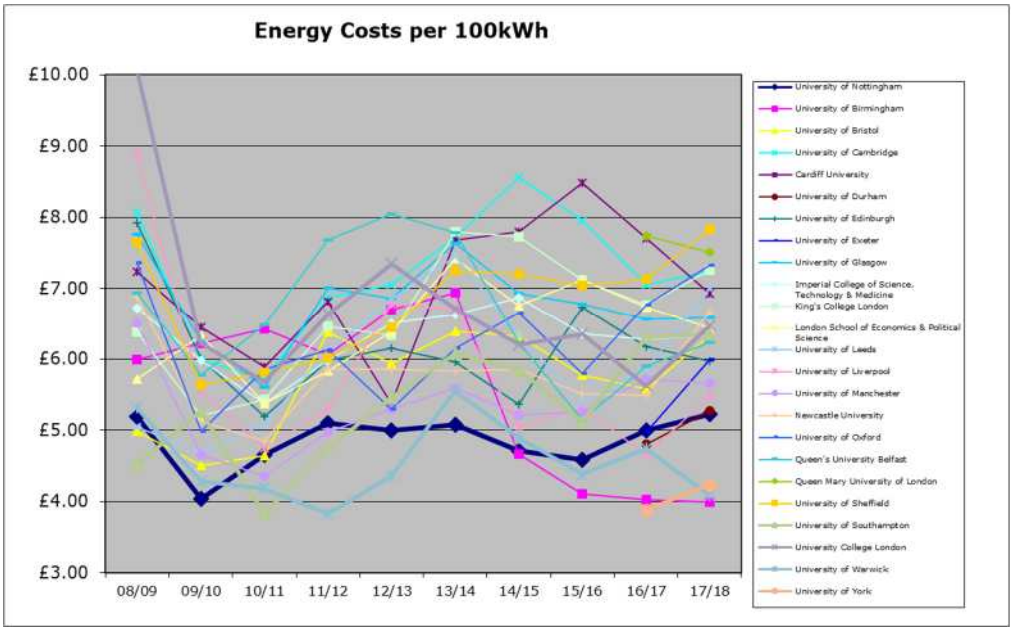


Figure 1.K.1 Graph of Russell Group Energy Costs per 100kWh.

5.B – Energy Costs Comparison

The graph above indicates that our energy prices continue last years trend and are the fourth lowest in the Russell Group, and the graph below shows our costs per M² are 7th lowest in the data set.

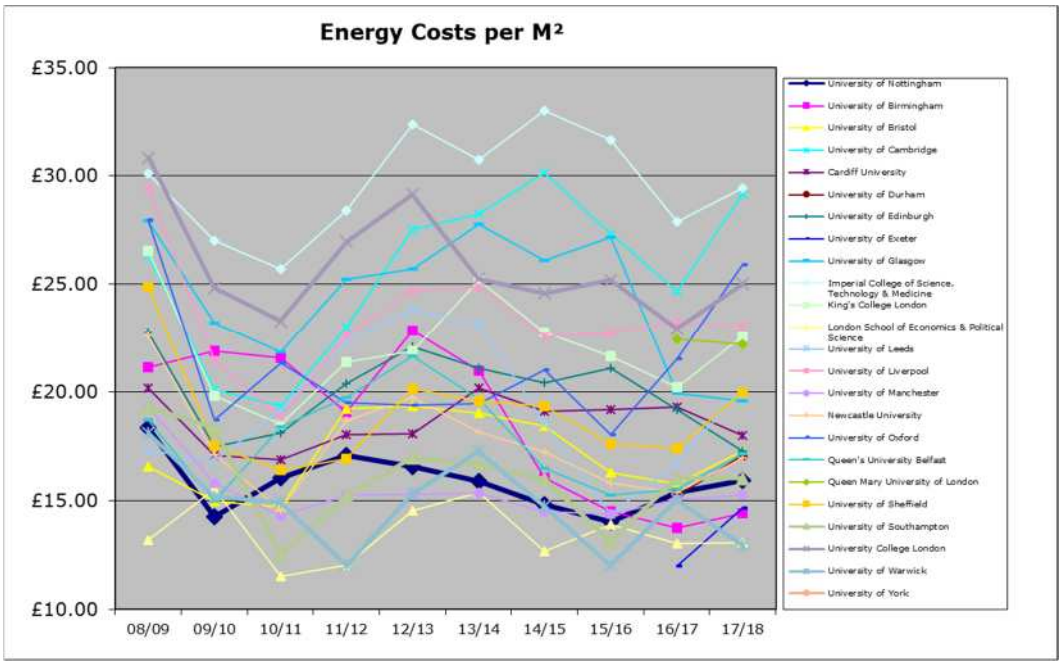


Figure 1.K.2 Graph of Russell Group Energy Costs square metre

5.C – Consumption per m²

The graph below indicate that Nottingham had an energy consumption of 305kWh/m^2 down slightly on last year and matching the average.

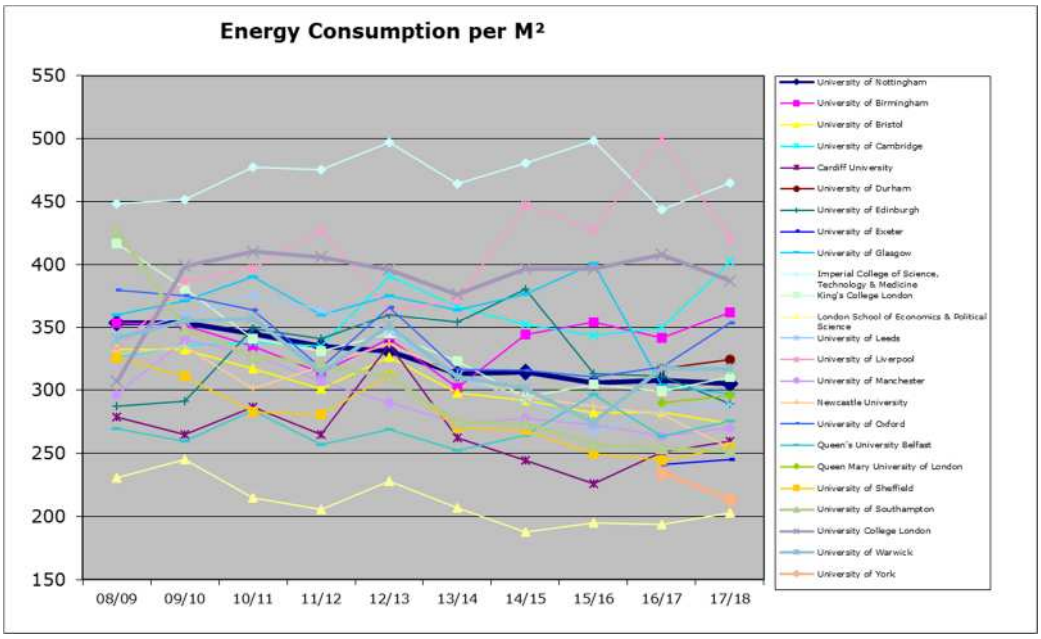


Figure 1.L.1 Graph of Russell Group Energy use per square metre.

5.D **Consumption per Student**

The energy use per student was also down slightly at 6,722kWh compared to last year and to the Russell Group average of 6,844kWh.

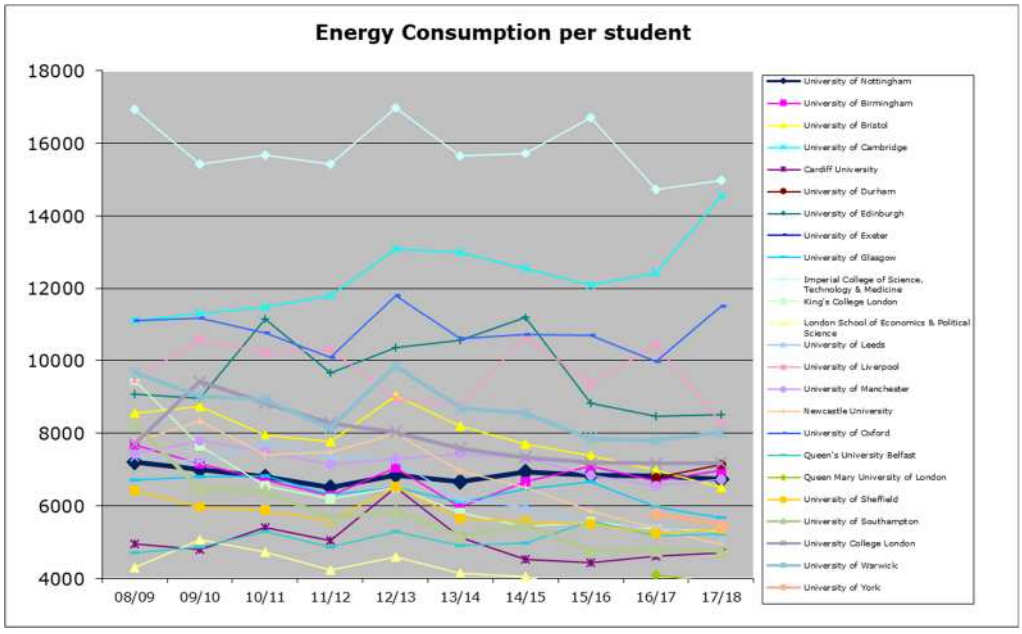


Figure 1.L.1 Graph of Russell Group Energy use per student