Carbon Management Plan
Annual Report 2012/13

University of Nottingham

Annual Report 2012/13 Carbon Management

Contents

Executive Summary

This is the University's 2012/13 Carbon Management Plan (CMP) annual report. It provides details on progress achieved and performance improvements made in reducing emissions of carbon dioxide (CO_2) against University targets.

The University's CMP was approved in December 2010 and can be found at www.nottingham.ac.uk/about/values/environment/carbonmanagement.aspx. The CMP includes targets for reductions in emissions of CO_2 from energy usage. It identifies the principal areas of energy use and investment programmes required to improve energy efficiency, reduce usage and generate energy from renewable energy sources.

Since the publication of the CMP in 2010 the University has already exceeded its new build growth allocation of carbon of 3,000 tonnes over 5 years, noting that the carbon emissions reporting methodology is based on absolute measurements with no allowance for business growth, increased activity or premises expansion. The University's assets on Nottingham Innovation Park and East Midlands Conference Centre Ltd are excluded from the reported figures.

The CMP also included an estimated carbon saving of 7,000 tonnes per year from wind turbines. The University has been unable to obtain planning permission to realise this project.

Excluding the wind turbine contribution, the annual carbon reduction target was 2,000 tonnes per year for the 5 year period to 2015/16. Compensating for the loss of the wind turbine contribution, the annual reduction target increases to 3,400 tonnes per year.

The third year's programme has invested £2.8 m in projects across all areas of the CMP, with predicted annual savings totalling £219k and 1,522 tonnes of CO_2. So far the CMP has resulted in investments in excess of £5.8m, with predicted annual savings in the region of 7,600 tonnes of CO_2 over the 3 year period.

The actual reported carbon emissions have reduced from 68,000 tonnes to 61,320 tonnes over 3 years which leaves a further reduction requirement of 7,320 tonnes to meet the 5 year target of 54,000 tonnes. This measured reduction has been aided by new emission factors published by DEFRA in 2013.

This year's investments have covered a range of areas, including plant replacement (boilers and chillers), Lighting upgrades including LED projects, continuation with insulation projects and double glazing projects.

Significant work has been done to explore campus wide low carbon energy solutions including a mixed renewable generation solution for Sutton Bonington, which is currently under review.

In December 2012 the University started the planting of its Diamond wood in partnership with the Woodland Trust, this 60 acre site will "lock up" on average 105 tonnes of Carbon Dioxide (CO_2) every year for 100 years, which is equivalent to the Carbon Dioxide produced by 40 houses every year for 100 years.

1 Introduction

This is the University's third Carbon Management Plan (CMP) annual report 2011/12. It provides details on progress achieved and performance improvements made against targets.

The CMP was approved in December 2010, with target CO_2 reductions to be delivered against timescales. The third year's programme has invested £2.8 m in projects across all areas of the CMP, with predicted annual savings totalling £219k and 1,522 tonnes of CO_2. So far the CMP has resulted in investment's in excess of £5.8m, with annual savings in the region of 7,600 tonnes of CO_2.

The report provides an update on energy and carbon dioxide (CO_2) 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. Over the coming year further work will be done to include the measuring of our scope 3 emissions.

The UK's Carbon Reduction Commitment energy efficiency scheme commenced in 2010. Details of the University's participation, performance and reporting requirements are summarised in section 5 of this report.

2 Carbon Management Plan – objectives and targets

The CMP was approved by the University in December 2010, with the 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 including switching off when not in use
3. generation of energy from small/medium scale renewable energy systems
4. provision of information and training to staff and students to engage them with the objectives of the Plan

The programme includes a number of specific investment projects and more generic programmes to deliver CO_2 reductions but require further detailed design to ensure maximum value for money is obtained. 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. CO_2 reductions from travel, procurement and waste (Scope 3) are not included within the scope of this report.

The CMP provides a baseline of CO_2 emissions, sets emission reduction targets and maps out a new 5 year investment programme to be implemented to deliver environmental performance improvements and carbon & financial savings[1]. The CMP targets and objectives included in the University Plan 2010-15 are as follows:

	Baseline 2009/10	Objective 2015/16
Total energy consumption p.a.	198 GWh	168 GWh
Total CO_2 emissions p.a.	68,000 tonnes	54,000 tonnes

These represent reductions from the 2009/10 usage of 15% on energy and 20% on CO_2 emissions by 2014/15. The targets require average annual reductions in energy consumption of 6GWh and CO_2 emissions of 2,800 tonnes; these are fundamental departures from historic rises seen in energy usage.

Assets of commercial subsidiary companies of the University at Innovation Park and East Midlands Conference Centre ltd. are excluded from reported figures.

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

3 UK's Carbon Reduction Commitment Energy Efficiency scheme

The Carbon Reduction Commitment Energy Efficiency Scheme (CRC) is a mandatory carbon emissions reporting and pricing scheme to cover all organisations using more than 6,000MWh per year of electricity (equivalent to an annual electricity bill of about £500,000). The CRC came into force in April 2010 to significantly reduce UK carbon emissions in non-energy intensive sectors in the UK. The sectors targeted by the CRC generate over 10% of UK CO_2 emissions, around 55 $MtCO_2$, and the scheme aims to reduce emissions from these organisations by at least 4 million tonnes CO_2 per year by 2020.

The University registered as a participant in the CRC in August 2010. There are three main differences in the requirements compared to the University's EMS reports:

- The CRC reporting periods use data from 1 April to 31 March
- CRC's definitions of building ownership result in the Medical School being excluded in the CRC carbon footprint
- Different emission factors, particularly of gas, are used by Defra to calculate CO_2 totals

The CRC Annual report were submitted to the Environment Agency in July 2013

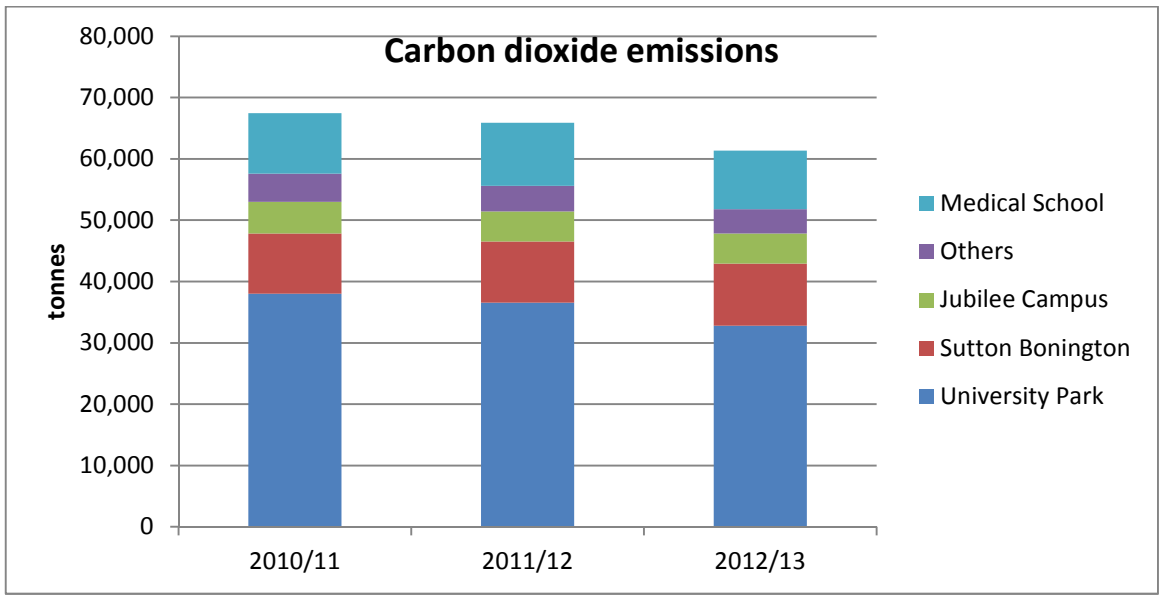
Under the Scheme, our emissions were reported as 55,796 Tonnes of CO2 (up from 51,276 in the previous reference, or 'footprint' year). Each tonne of CO2 emitted needs to be covered by an 'allowance', which costs £12. The University therefore purchased 55,796 allowances for a cost of £669,552.

Note that this cost, averaged out across our total energy consumption, equates to 0.312p/kWh.

4 Performance achieved

4.1 Carbon dioxide emissions (Scope 1 and 2)

In 2012/13 carbon dioxide emissions fell by 4,581 tonnes despite an increase in floor area of 3.5%, and a 3.3% increase in student numbers, this is partly due to the rebalancing of emission factors and the investment in carbon projects.



CO_2 Emission Factors	2010/11	2011/12	2012/13
Electricity kg/kWh	0.541	0.541	0.48357
Gas kg/kWh	0.204	0.204	0.18404

CO2 Emissions			
	2010/11	2011/12	2012/13
University Park	38,007	36,545	32,814
Sutton Bonington	9,804	9,964	10,103
Jubilee Campus	5,192	4,942	4,892
Others	4,587	4,161	3,994
Medical School	9,865	10,289	9,519
Total	**67,454**	**65,901**	**61,320**

4.2 Electricity

Electricity consumption was up by 2.2%. New buildings added 1,630MWh. The contribution of new buildings includes the Energy Technologies Building 532MWh, Aerospace 175MWh and the Si Yuan Centre 92MWh. Several other buildings completed in 2012/13 showed increases as they reached full occupancy.

Progress is being made in this area as overall electricity consumption was 79,401MWh back in 2008/9, meaning that consumption increases including all new buildings, etc. have been kept to just 1.9% in the last four years

4.3 Fossil Fuels

Consumption of fossil fuels rose by almost 11%, which was actually an impressive performance given the unusually cold winter. In a like-for like situation, the weather alone would have been responsible for an 18% increase in consumption. Additionally, total floor area increased by 3.5% in the year, so an efficiency gain of 10.7% was achieved overall.

A more detailed analysis of the figures shows a particularly impressive performance at University Park, as a result of a 13% year-on-year reduction at the Central Heating Station. This was achieved in the face of the cold weather as a result of a review of system settings plus work to reduce fume cupboard losses in Chemistry.

The increase at Sutton Bonington was largely down to the Main Boiler house figure being artificially low in 2011/12 as a result of the gas meter under-recording. The rise at Jubilee Campus was down to new buildings coming on-line.

Further details and a full breakdown of electricity and fossil fuel usage campus by campus and major buildings can be found in the University's 2012/13 Energy Report.

4.4 Targets

The targets set in the CMP require annual CO_2 emissions to fall from 68,000 tonnes in 2009/10 to 54,000 tonnes by 2015/16, a reduction of 14,000 tonnes. The programme includes a reduction in emissions from the proposed Grove Farm wind farm of 6,200 tonnes per year by 2015.

The remaining programmes would need to deliver savings of 7,800 tonnes – this would equate to providing savings on average of 1,560 tonnes each year throughout the five year period plus pro rata saving of 600 tonnes each year to support projected new build additions, based upon a projected 3,000 additional tonnes from new development.

Since the publication of the CMP in 2010 the University has exceeded its growth plan and the carbon associated with the Universities development has already exceeded its projected additional carbon of 3,000 tonnes. Over the remaining life of this plan the University will continue to expand its capital program.

Realigning this including for the provision of the wind turbine project which is currently subject to a planning appeal will require the delivery of on average of 2,760 tonnes each year factoring in a new build allowance of 1,200 tonnes per annum. (6,000 additional tonnes over the life of the plan).

5 Carbon projects

5.1 Carbon Management Plan projects

A summary of carbon saving projects installed in 2012/13 together with totals for investment in 2010/11 and 2011/12 is given below. Projects are grouped into the main CMP themes together with their financial and carbon performances.

Project theme	Project description	Investment cost £	Estimated annual savings	
			Financial £	CO_2 tonnes
Improvements to building fabric, glazing and insulation	Roof Insulation, Cavity Insulation, Double glazing and plant room insulation	1,691,943	69,458	429.5
Laboratories: Continuation of Fume Cupboard works	Upgrade of fume cupboard controls, invertors, fume cupboard storage rationalizing and upgrade of fume cupboards with VAV.	150,300	50,172	449
Chiller Upgrades	Replacement of old chiller units with new compliant chillers	152,300	2,142	14
Boiler Replacements and controls	Replacement of old inefficient boilers for more efficient models in halls of residence, program of improved building sensor controls	364,660	27,893	191
Pump Upgrades	Installation on invertors, replacement pumps and software modifications	25,852	3,893	33
Ventilation and Cooling	Instillation of more efficient ventilation systems and the installation of advanced control systems	308,514	44,343	197
Lighting upgrades	Lighting controls (motion and day lighting)	113,044	21,940	103
Diamond Wood	Annualised contribution from the planting of the diamond wood at Sutton Bonington			105
Total for 2012/13		**2,806,613**	**219,481**	**1,522**
Total for 2011/12		1,489,937	350,467	2,028
Total for 2010/11		1,509,361	686,424	4,096
Total for 3 year period		**5,805,911**	**1,256,372**	**7,646 7,646**

5.2 Project summary

A full schedule of projects is included in appendix 1 and provides details of type, location, capital spend and calculated annual energy, financial and carbon savings.

Improving the thermal performance of our buildings remained a high priority over the last year with a number of insulation projects carried out. Several buildings have had single glazing replaced with double glazing improving the thermal performance of the building and improving the comfort for occupants.

We have continued with the laboratory fume cupboard efficiency programme with further works to reduce fan speed and also the rationalization of storage to deliver reduced electricity use and reduced gas from space heating.

The replacement of old plant, both chillers and boilers has resulted in improved efficiency across the estate and this rolling programme will continue over coming years.

A significant investment in building management sensors and zoning has improved thermal comfort within a number of buildings and allows for the more efficient use of heating systems.

A chiller replacement programme has commenced, replacing old inefficient units with high efficiency systems and better controls.

5.3 Renewable energy projects

Low and medium scale renewables are financially supported by UK legislation – the Feed in Tariffs (FITs) and Renewable Heat Incentive (RHI). These programmes promote widespread uptake and provide income from generation to accredited technologies including photovoltaics (PV), wind, biomass, solar thermal and ground source heat pumps (GSHP). Below is a summary of the renewable energy generation in the last 12 months.

Building	Technology	Annual Production (kWh)
Dearing	PV	8,491
Business School North	PV	18,257
Computer Sciences	PV	7,900
Derby Hall	PV	52,544
Lincoln Hall	PV	53,237
Si Yuan Chinese Studies	PV	9,200
Aerospace Technology	PV	12,600
Environmental Education Centre	PV	15,500
Sustainable Research Building	PV	7,600
Total		**185,329**
Rutland & Sherwood Hall	Solar thermal	15,250
Si Yuan Chinese Studies	Solar thermal	2,225
Geospatial	Biomass	75,000
BioEnergy	Biomass	165,000
Total		**257,475**

These installation have saved 136 tonnes of Carbon and have generated in excess of £45k in revenue from the governments Feed in Tariff and Renewable Heat Incentive.

5.4 Sutton Bonington Diamond Wood

In 2012/13 the University was chosen as part of the Woodland Trust's Jubilee Woods project, which aimed to plant 6 million trees in honour of the Her Majesty The Queen's 2012 Diamond Jubilee, creating beautiful new woodlands as a lasting legacy.

The Diamond Wood, split between two sites in the village of Sutton Bonington has been designed not only as a native woodland, but also as an educational resource demonstrating biodiversity and sustainability in woodland practices.

The site comprises of different types of habitat: native woodland, Alder, Willow and shrub planting area and a wet woodland habitat area. The site also includes specimen trees, a pond and incorporates a focused teaching area. The wood is still in its infancy, but areas such as the nature pond will hopefully establish within one or two years. To encourage a wide variety of different plant and animal species throughout the year, the woodland has been sown with flowering plants to create ground level interest and cover.

Creating new woodland requires careful planning, design and the selection of specific tree species. The aim of the Diamond Wood project is to create new areas of native English woodland planted with tree and plants that are common in the British Isles. Over 50% of the total area of the Pasture Lane site has been planted with native woodland trees including: English Oak, Field Maple, Hawthorn and Downy Birch. Over time these trees will form native high canopy cover.

The creation of any new woodland will have a passive impact on the local carbon produced or stored within an area. It has been calculated that the Diamond Wood will "lock up" 105 tonnes of Carbon Dioxide (CO_2) every year for 100 years, which is equivalent to the Carbon Dioxide produced by 40 houses every year for 100 years.

5.6 Audits and feasibility studies

A significant amount of work has been carried out looking at the long term energy strategies of both University Park and Sutton Bonington. The Scheme for Sutton Bonington is the one most developed and the current proposal is for a mixed blend of established technologies utilising Renewable Electrical generation schemes, Photo Voltaic Array (PV) and Wind turbine Technology which now benefit from various recent government feed in tariffs which further incentivise their use. Combined heat and power plant (CHP), which now benefits from the latest efficiency gains and the possible use of Bio Oils fuel source to potentially offer near zero carbon energy generation, completes the mix. Further detail is below.

145kW (peak) Roof mounted PV Array

Roof mounted option for the Clinical wing of the Vets school, totals approx. 1000m2 and would generate an estimated Electrical annual output of 127,115kWh with saving of 69 tonnes CO_2. The total cost of this scheme is £223K inclusive connection and VAT. The annual cost savings are £26K, comprising of £12K in reduced electrical costs and £14K from the feed in tariff.

800kWe Gas fired CHP

800 kWe CHP unit that will also produce 968 kW of thermal energy in the form of Low Pressure Hot Water (LPHW) at nominal flow and return temperatures of 80/70°C. This would utilise the existing site distribution mains that serve over 50% of the existing building stock. The CHP plant would provide the heating season base load for the site system with the existing gas fired boiler plant retained to provide the remaining winter load and standby plant should the CHP go off line.

Based on the existing heating load profiles and an assumed 90% availability of the CHP plant this would give an approximate total run hours of 7884hrs per year, an estimated 5782MWh

electrical output and 7683 MWh thermal output. This would result in net savings of approximately 1612 tonnes CO2 and energy cost saving including maintenance of £310k per annum. The estimated total cost for installation of the CHP unit complete with existing infrastructure upgrades etc. is £1,549k inclusive of VAT giving a simple payback of approx. 5 years.

400kWe Gas and 477kWe Bio Oil CHP

This split option for CHP plant gives an additional 1,741 tonnes of CO2 saving but at the expense of
significantly increased fuel cost 8.5p /kWh (vs 3p for Natural Gas) and possible future fuel cost stability issues.
Based on the existing heating load profiles and an assumed 90% availability of the CHP plant this would give an approximate total run hours for the 2 units of 11,793hrs per year, an estimated 5347MWh electrical output and 7692 MWh thermal output.

This would result in net savings of approximately 3354 tonnes CO2 and energy cost loss of between £41K and £130k per annum depending on equivalent feed in tariffs for Bio Oil fuelled CHP (between 50% and 100% of ROC's)The estimated total cost for installation of the CHP unit complete with existing infrastructure upgrades etc. is £1,733k inclusive of VAT.

500kW (peak) Wind Turbine

A 500kW wind turbine situated near the dairy farm would generate an estimated annual output of 1,633,000kWh with savings of 885 tonnes CO_2 based on a mean wind speed of 6.1m/s at the turbine hub height. The annual cost savings, including maintenance, are £422k, comprising £155K in reduced electrical costs and £295K from Feed in tariff (18p/kWh). The cost of this system is £1,782k incl VAT, which includes a cable to connect to our electrical network, giving a simple payback period of 4.1 years.

These projects are currently being refined to be presented to Management Board for an agreement in principle

6 Future carbon management and investment programmes

Over the coming year we will continue to deliver the depth and range of carbon projects, continuing with plant replacement, glazing and insulation projects and at the same time focus on major schemes such as the Sutton Bonington low carbon strategy.

The outcome of the wind turbine application will be known in the next year and this will indicate the direction that we will go. A greater emphasis will be placed on staff and student engagement to maximise potential savings through direct user engagement.

The programme continues the focus on investment in the CMP's main areas based

- Plant Replacements
- Laboratory efficiency program
- Campus wide low carbon generation strategies
- Staff and student engagement
- Improved controls and additional sensors
- renewable energy installations

7 Financial requirements

CMP projects continue to be assessed for financial and carbon performance and submitted for approval, having initially gone through a carbon reduction working group. Funding for CMP projects is provided from CMP capital, revenue expenditure, Salix finance and grant contributions and loans.

7.1 Salix Finance

The University continues to utilise its Salix Finance revolving green fund and has used it to invest more than £525K in carbon saving projects to date and will continue to invest these ring fenced savings into further carbon saving projects. Investments this year have included the installation of cavity and roof insulation and lighting controls.

7.2 HEFCE funding

The University secured £142k from HEFCE's Revolving Green Fund to support the carbon management program. The RGF provides recoverable grants to institutions for projects that reduce their emissions.

Appendix 1 – Carbon Management Plan projects 2012/13

Project	Location	Technology description	Investment Cost (incl VAT) £	Estimated Annual Savings Financial £	CO2 tonnes	Energy kWh	Payback period (years)
Double Glazing	Clive Granger Phase 2 / 3	double glazing	250,000.00	3,197	22	106,573	78
	Biology	double glazing	115,000.00	2,798	19	93,256	41
	L2 building	Insulated window panels (492m2)	40,000.00	849	6	28,290	47
	L3 building	Insulated window panels (175m2)	20,000.00	302	2	10,062	66
	L4 Building	Insulated window panels (434m2)	40,000.00	750	5	24,995	53
	Sir Clive Granger	double glazing	205,000.00	2,834	19	94,450	72
	Psychology reaming facades	double glazing	75,000.00	1,140	8	38,000	66
	Pharmacy remaining 1	double glazing	68,000.00	1,080	7	36,000	63
	Pharmacy remaining 2	double glazing	71,000.00	1,110	8	37,000	64
	Coates C1/3 and 4	double glazing (220m2)	80,500.00	1,935	13	64,500	42
Flat roof replacement	Hallward Library	flat roof insulation	300,000.00	5,610	38	187,000	53
	Medical school	Part flat roof insulation 3000m2	230,000.00	15,950	65	319,000	14
	Portland roof	Part flat roof insulation	68,000.00	515	4	17,157	132
Insulation	Biology walls	Insulation	7,200.00	474	3	15,810	15
	Coates C1/3 and 4 walls	Insulation	7,200.00	483	3	16,100	15
	Lenton Hurst	Roof Insulation	2,838.00	598	4	19,949	5
	The orchards	Roof Insulation	946.00	787	5	26,235	1
	Highfields	Roof Insulation	1,315.00	1,094	7	36,467	1
	Engineering Manufacturing Building	Cavity Wall Insulation	3,360.00	1,596	11	53,196	2
Sensors	Lenton & Wortley Hall	additional sensors	10,100.00	1,428	10	47,600	7
	Derby Hall	additional sensors	10,100.00	1,764	12	58,800	6
	Rutland	additional sensors	10,100.00	1,260	9	42,000	8
	Nightingale	additional sensors	10,100.00	1,260	9	42,000	8
	Hugh Stewart	additional sensors	10,100.00	2,268	15	75,600	4
	Coates	additional sensors	14,400.00	2,775	19	92,500	5
	Pope	additional sensors	7,700.00	745	5	24,833	10
	Tower	additional sensors	7,700.00	1,300	9	43,333	6
	Physics	additional sensors	4,600.00	1,688	11	56,250	3
	Sir Clive Granger	additional sensors	5,760.00	1,200	8	40,000	5
	Portland	additional sensors	14,400.00	2,312	16	77,083	6
	KMC	additional sensors	4,600.00	2,625	18	87,500	2
Lighting upgrades	Newark Hall Pantries	Controls	2,951.00	904	5	9,315	3
	Derby Hall Corridors	Controls	4,722.00	1,751	10	18,048	3
	KMC Corridor	Controls	13,326.00	2,936	16	30,261	5
	Boots Science	Corridor lighting controls	5,281.00	4,063	6	10,952	1
	Sherwood Hall	Corridor lighting controls	10,970.00	2,479	14	25,548	4
	Rutland Hall	Corridor lighting controls	10,794.00	3,977	22	40,995	3
	Jubilee Campus	Controls	65,000.00	5,380	30	55,453	12
Chiller replacement based on R22 phase out requirement - 2012 to 2015	MRI	chiller replacement	26,400.00	256	1	2,636	103
	MRI	chiller replacement	6,600.00	42	1	434	157
	MRI	chiller replacement	6,600.00	42	1	434	157
	MRI	chiller replacement	13,200.00	139	1	1,433	95
	MRI	chiller replacement	7,500.00	113	1	1,162	67
	MRI	chiller replacement	16,000.00	169	1	1,747	94
	The Firs (surgery 2)	chiller replacement	25,000.00	442	2	4,555	57

	JCG Library	chiller replacement	18,000.00	184	1	1,895	98
	The Willows (Rabbit House)	chiller replacement	25,000.00	351	2	3,615	71
	The Willows (LAR)	chiller replacement	8,000.00	405	2	4,175	20
Boiler Replacement	Sherwood Hall	Boiler replacement	45,000.00	1,667	11	55,556	27
	Nightingale Hall	Boiler replacement	45,000.00	1,306	9	43,529	34
	Florence Boot Hall	Boiler replacement	45,000.00	1,306	9	43,529	34
	Willoughby Hall	Boiler replacement	45,000.00	1,765	12	58,824	25
Boiler heating system upgrades	Cripps Hall	Improvements to heating zoning and controls	45,000.00	710	6	27,895	63
	Lenton and Wortley hall	Improvements to heating zoning and controls	30,000.00	515	4	21,052	58
Plant Room/ Pipework Insulation	Plant Room Insulation	Insulation	45,645.00	11,847	82	400,000	4
	Plant Room Insulation phase 2	Insulation	45,000.00	8,100	57	270,000	6
	Cripps Hall Plant Rooms	Pipework thermal Insulation	15,939.00	6,500	41	173,361	3
Fume Cupboards	Chemistry C8/10	42 FC's in teaching labs upgrade controls and inverters	26,400.00	14,600	130	407,229	2
	CBS Labs C22,C25,C28,C30	CBS Reduction of extract rate at low sash position	20,400.00	14,000	113	346,783	2
	Chemistry B11	Seprate extract fan for FC storage cabinets	12,000.00	5,500	49	150,447	2
	Chemistry B11	Sash stop to 400mm	3,000.00	650	5	20,573	6
	Chemistry C31 & C33	400mm sash and discharge mods	5,500.00	2,000	20	70,122	3
	CBS Labs C22,C25,C28,C30	Night temp set back to 12 C	Nil	5,200	42	143,678	
	Chemistry Surface Science	3 off replacement VAV Fume Cupboards	48,000.00	4,922	51	226,964	10
	Chemistry B19/B21	3 off replacement Fume Cupboards	35,000.00	3,300	39	172,481	11
Pumps	Plant Sciences	Install inverters to CW pumps	5,820.00	1,351	7	13,505	4
	Medical School	Install inverters to CT pumps	14,400.00	2,190	24	43,800	7
	Hallward Library	New water booster pump	5,632.00	352	2	3,518	16
	Trent Building	VT pump replacement	13,000.00	450	3	4,500	29
	CT pumps HPHW plant rooms	Software modifications	Nil	2,233	12	22,328	
	Lenton and Wortley Dining room	Upgrade heat pumps / controls	8,400.00	1,060	5	9,259	8
AHU	Plant Sciences	Install inverter on AHU's	22,670.00	3,800	22	40,114	6
Ventilation/ Cooling	Plant Sciences	Install DX cooling	20,027.00	3,577	20	36,500	6
	Boots Science	Install PIR co2 sensors to lecture theatre	2,021.00	418	3	9,282	5
	Sir Clive granger B29/ B29a	Replace cooling to IT lab	21,396.00	3,794	22	39,944	6
	Pope Building A26	Install PIR to AC units	500.00	333	2	3,700	2
	Pope Building A25	Install PIR to AC units	500.00	278	2	2,777	2
	Medical school	Controlled ventilation to D and E voids	220,000.00	28,400	108	541,015	8
Carbon Capture	Diamond Wood	Planting of Woodland	Nil		105		

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