The University of Nottingham

UNITED KINGDOM · CHINA · MALAYSIA

Carbon Management Plan 2010-2020

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Contents

Introduction

This Carbon Management Plan sets in place the University's target reductions in carbon dioxide (CO_2) emissions to 2020 and identifies a framework for investment over the next 5 years that will be required to deliver CO_2 savings to meet University targets. The report identifies the main proposed areas of activity, and will evolve over time as new opportunities are identified and brought forward. The Plan has been developed to respond to the UK and HE sector CO_2 emission reduction targets and will deliver both environmental performance improvements and financial savings. It requires a new carbon investment programme to be implemented to meet these targets, with the main areas of investment 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
5. a cultural change in the use of high energy consumption activities within premises and a strategy to replace with lower energy alternatives.

The Plan requires engagement at all levels of the University – from individual behavioural changes to institution led initiatives – in order that the objectives are understood and that contributions are made to maximise delivery of the targets. We want to foster a 'can do' approach and response across the University.

The programme includes a number of specific investment projects in the first two years. It also provides more generic programmes that have identified 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 and will be assessed separately as required by any future legislation and sector guidance.

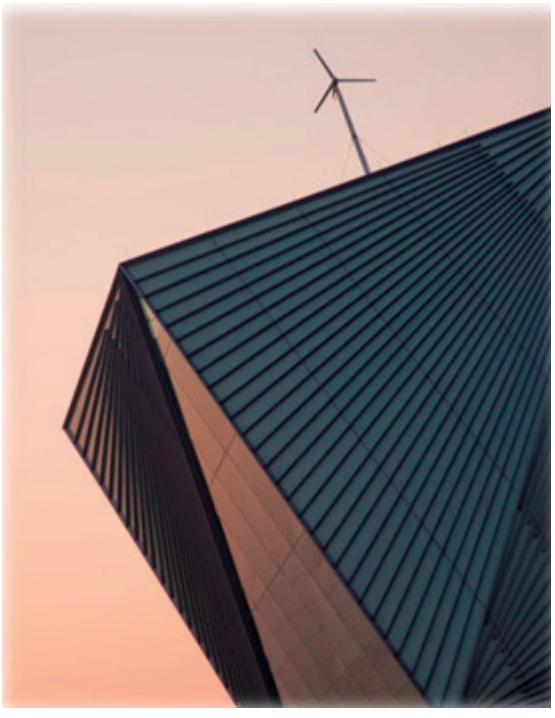
The 5 year Plan targets and objectives are included in the University Plan 2010-15. The focus to ensure we achieve our aims by 2015 include 'Move towards carbon-neutral energy performance through a major new carbon investment programme' and 'Raise awareness of environmental sustainability among staff and students'. Our performance targets are summarised as:

	Baseline 2008/09	Objective 2014/15
Total energy consumption p.a.	198 GWh	168 GWh
Total energy emissions p.a.	68,000 tonnes	54,000 tonnes

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. Furthermore this Plan will be used as the blueprint to develop carbon baselines for our overseas campuses by 2012, a requirement of the University Plan, and subsequent carbon reduction strategies for all campuses for the period 2015-20.

An annual report will be produced to monitor and report on our progress and performance achievements against this plan and to provide an update on the CO_2 reduction projects that will ensure that the remaining targets and objectives are met.

UK Carbon Policy



The sector as a whole is embracing the environmental agenda, indeed as early as 2005 HEFCE set out a vision that: 'Within the next 10 years, the higher education sector in this country will be recognised as a major contributor to society's efforts to achieve sustainability – through the skills and knowledge that its graduates learn and put into practice, and through its own strategies and operations.'

Carbon management is becoming of increasing importance at global and local levels. The UK has set legally binding CO_2 reduction targets and, in turn, funding bodies including HEFCE are reflecting these in their strategies, investment criteria and reporting requirements. Key aspects in HEFCE's strategy include:

- Establishing a more demanding approach to delivering carbon reductions via institutions' carbon plans. Targets for the sector are to reduce direct emissions and those caused by electricity purchases by 43% by 2020 and 83% by 2050 (both against a 2005 baseline).
- Adapting the Capital Investment Framework to establish a link between performance against carbon plans – in effect, carbon reduction – and future capital allocations.
- Measure and report progress against the sector-level targets.

The Carbon Reduction Commitment Energy Efficiency Scheme registration commenced in April 2010, with some 5000 organisations participating in this. Each year from 2012 the University will be taxed on its carbon emissions, this will cost c. £750k, based on a rate set at £12/tonne CO_2. Evidence from other UK environmental taxation policies would suggest that there is a strong likelihood that these costs could rise significantly in future years.

The development and publication of the University's Environmental Strategy in March 2010, coupled with the University Plan, explicitly set the scene and agenda for delivering carbon reductions across the University.

University Carbon Baseline

Consultants SQW were commissioned by the Higher Education Funding Council for England (HEFCE) to calculate estimated carbon dioxide emissions baselines for each higher education institution (HEI) for two years:

1. 1990/91 as the year against which most national and sectoral targets are set

2. 2005/06 as a more recent year for which high quality data are available.

The individual HEI baselines calculated cover Scope 1 and Scope 2 emissions as defined in the 2004 Greenhouse Gas Protocol and adopted by the Department for Environment, Food and Rural Affairs (DEFRA). More specifically, the following emissions have been included:

1. Scope 1 – direct emissions from the combustion of fossil fuels within the HEI estate, such as natural gas, heating oil, coal and other fuels, as well as in assets owned by the institution such as motor vehicles (petrol, diesel and other transport fuels).
2. Scope 2 – indirect emissions associated with the consumption of purchased electricity within the institution's estate

The carbon conversion factors used for the 2005/06 baseline are:

Natural gas	0.18523 kg CO_2 per kWh
Petrol	2.3220 kg CO_2 per litre
Diesel	2.6720 kg CO_2 per litre
Grid electricity	0.53909 kg CO_2 per kWh

Summary of SQW baseline results for the University of Nottingham (see Appendix 1 for detailed breakdown):

1990/91	**Total carbon emissions**	**42,643 t CO_2**
2005/06	**Total carbon emissions**	**57,163 t CO_2** *

*omitted fossil fuel consumption of 26,312 MWh for Medical School equating to 4,874 t CO_2 emissions.

Revised 2005/06	**Total carbon emissions**	**62,036 t CO_2**

Recent Performance Trends and KPIs

Over the 4 year period between 2005/06 (the sector performance baseline) and 2009/10, CO_2 emissions have increased by 5962 tonnes with the following trend changes in consumption and emissions:

1. Total energy consumption +6.3%
2. Total CO_2 emissions +9.6%

Table 1 summarises the annual energy consumption and CO_2 emissions arising from usage of electricity and gas at the university's UK campuses.

	2005/06		2007/08[1]		2009/10[1]	
	MWh	t CO_2	MWh	t CO_2	MWh	t CO_2
Carbon conversion factors (MWh to t CO_2): Natural Gas Grid Electricity	0.185 0.539		0.206 0.523		0.204 0.541	
University Park	109,088	35,910	111,718	37,610	115,831	39,071
Sutton Bonington	25,818	8,489	28,605	9,402	29,035	9,650
Jubilee Campus	9,939	3,579	10,742	3,886	12,566	4,866
Others	10,544	3,416	11,812	4,065	12,699	4,410
Medical School	36,516	10,375	36,403	10,707	33,790	9.731
Transport		267		270		270
TOTAL	**191,905**	**62,036**	**199,279**	**65,940**	**203,921**	**67,998**

Table 1: Total consumption and CO_2 emissions

[1] Data calculated using HEFCE EMS CO_2 emission factors

Table 2 takes into account growth and compares CO_2 emissions on a like for like basis.

	2005/06		2007/08		2009/10	
	MWh	t CO_2	MWh	t CO_2	MWh	t CO_2
Additional Buildings	0	0	5,455	1,983	10,711	3,631
AMENDED TOTAL[2]	**191,905**	**62,036**	**193,824**	**63,957**	**193,210**	**64,367**

Table 2: CO_2 emissions on a like for like basis

'Like for like' performance trends for 2005/06 assets with no additional buildings

- **Total energy consumption +0.7%**
- **Total CO_2 emissions +3.8%**

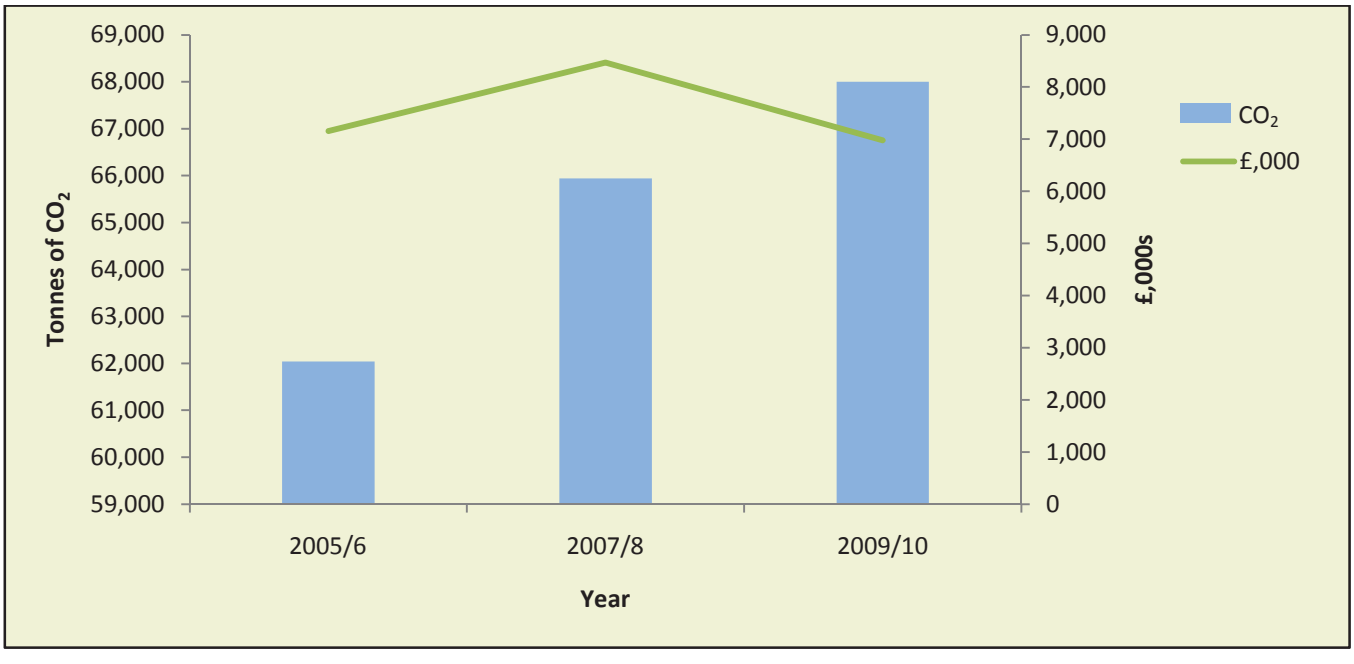


Figure 1: Total absolute CO_2 emissions and energy spend

[2] Amended total reflects performance on like for like basis from 2005/06 onwards.

Figure 2 summarises absolute CO_2 emissions by energy source (Scope 1 and 2).

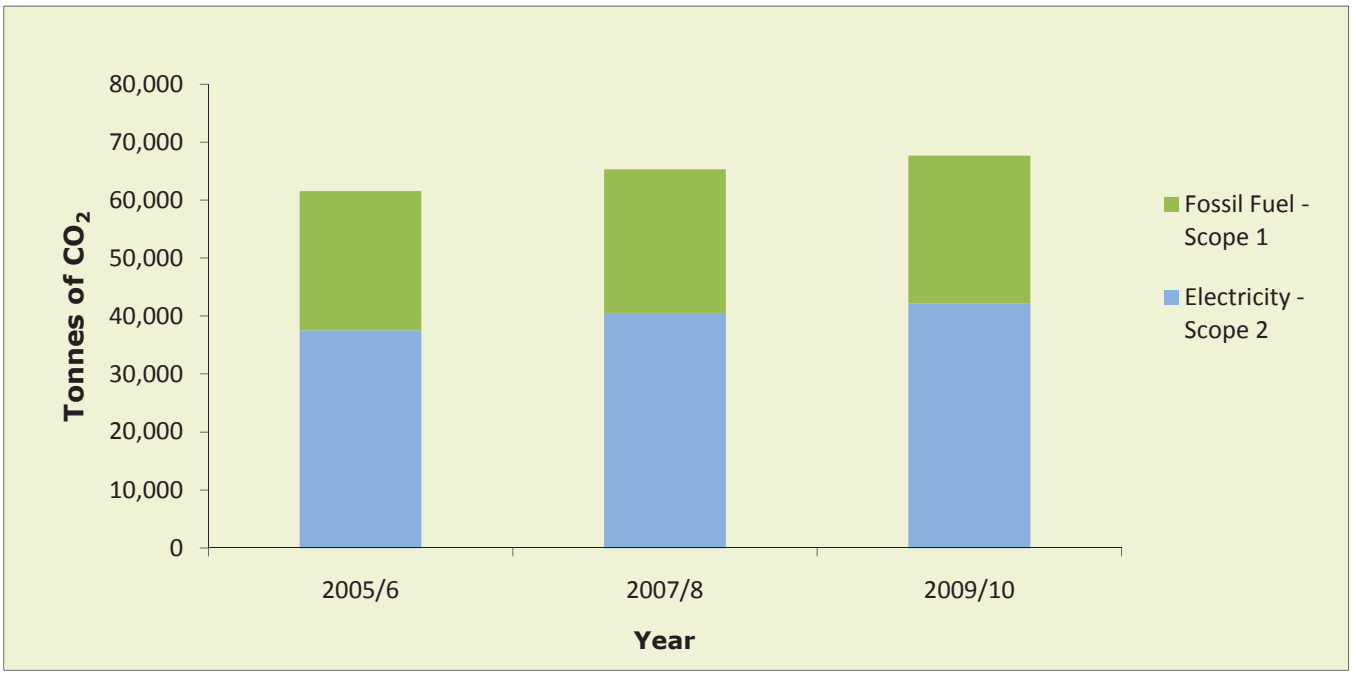


Figure 2: absolute CO_2 emissions by energy source

Figure 3 below gives a weekly profile of electricity usage across all University UK campuses. The diurnal pattern reflects switching on and off equipment at the beginning and end of the main working hours Monday to Friday, with lower usage at weekends. The high baseload of 6000 kW includes equipment in use for a number of reasons including research, IT and building plant operation. However a proportion of this represents equipment and systems left on for convenience rather than need. A key aspect of the Plan is the identification of the build up of this baseload and to develop efficiency and operational changes in order for this to be reduced.

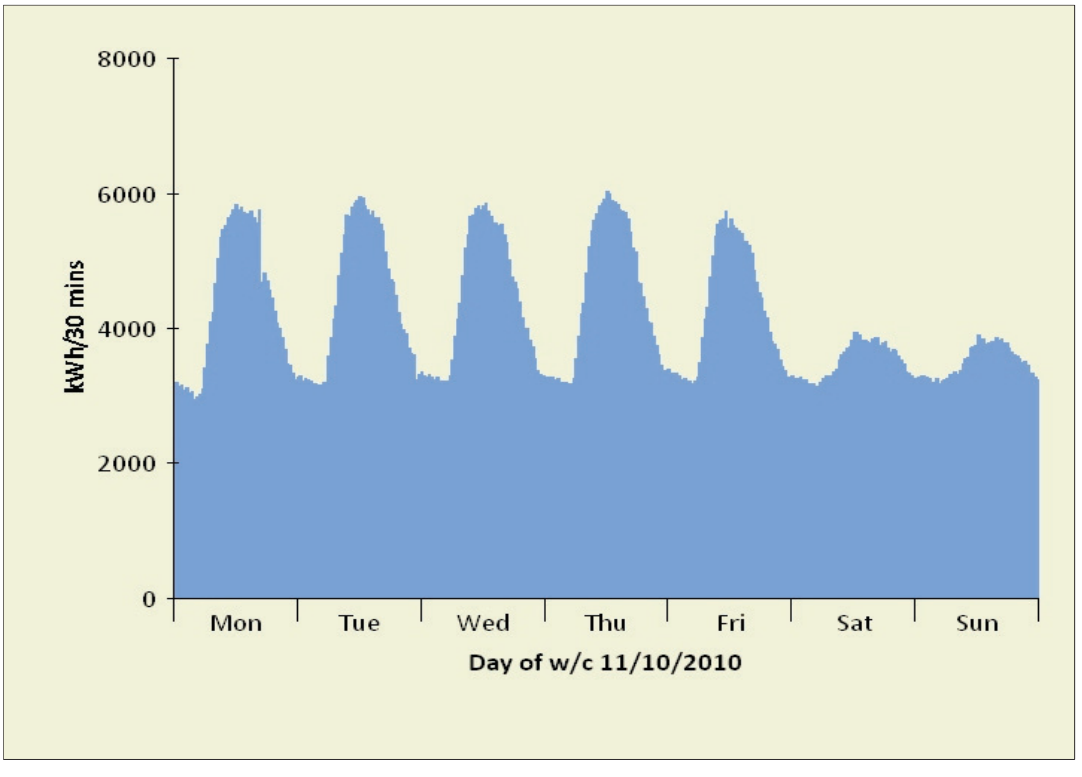


Figure 3: University of Nottingham electricity usage

For relative carbon baselining, the SQW report commissioned by HEFCE has identified total FTE of staff and students combined, and the total income of HEIs as reporting Key Performance Indicators (KPI). It is also considered appropriate to report against the changes in size of the physical assets and include HEI gross internal area (GIA). Table 3 summarises the reporting trends since 2005/06.

	Emissions ($t CO_2$)	Staff & Students (FTE)	Emissions per FTE ($kg CO_2$/FTE)	Income (£M)	Emissions per unit of income ($kg CO_2$/£)	GIA (m^2)	Emissions per area ($kg CO_2/m^2$)
2005/06	62,036	30,906	2,007	346	0.179	473,489	131
2009/10	67,998	34,878	1,950	454[1] (507)	0.150	577,872	118
Change	**+9.6%**		**-2.9%**		**-16.2%**		**-10.0%**

[1]Actual income, (£507M) reduced by GDP deflator 10.5%

Table 3: CO_2 emissions and KPI trends summary

University Targets

The targets set within the HEFCE carbon reduction strategy align with UK targets and are seeking an absolute reduction across the sector, against a 2005/6 emissions baseline. It is important to note that HEFCE has not set individual institution reduction targets, but is seeking an overall reduction across the whole sector. However there will be a requirement to demonstrate how we are contributing to the overall sector target through future HEFCE capital allocations.

The University Plan commitment is for a 20% absolute reduction in CO_2 emissions from a 2009/10 level to be achieved by 2015. **This will equate to a 13% absolute reduction from our 2005/06 baseline.**

The University Plan includes for an expansive capital program over the next 5 years. Even though the University ensures that its developments are BREEAM excellent as a minimum, development within a research led university will inevitably result in an underlying growth in energy use from these new buildings. The estimated new build increase to 2015 is circa 30000m^2 and a corresponding estimated annual increase in CO_2 of circa 3000 tonnes.

On a like for like basis taking into account expansion of the estate, the planned reduction in CO_2 emissions by 2015 will equate to a reduction of 24% from the 2009/10 level.

For the period 2015 to 2020, our target would be to reduce our absolute carbon emissions to 41,000 t CO_2 per annum. This will equate to a total reduction of 40% from our 2009/10 level and 34% reduction from our 2005/06 baseline.

This strategy equates to a 34% absolute reduction in carbon emissions by 2020 from our 2005/06 baseline.

Strategic Themes

The University's Environmental Strategy's aims include:

> improve the environmental performance of our buildings and the University's physical infrastructure by moving towards carbon neutral energy performance, adopting environmentally conscious procurement practice, promoting renewable energy systems, reducing water consumption and waste output.

The objectives in delivering this are centred on: reducing energy usage, costs and waste; generating energy from renewable energy sources, and specifying carbon neutral or low carbon energy products via procurement and energy contracts.

Projects have been carried out by Estates for many years to reduce energy use: in our new building designs, high efficiency boilers, monitoring and control of buildings' heating usage and installation of low energy lighting. However we continue to see upward trends in energy use – this is due to a combination of developing our estate, installation of energy intensive equipment and also the way usage has changed.

The Carbon Management Plan will be the principal investment programme for delivering CO_2 emission reductions. It prioritises initiatives and provides investment levels, energy savings and financial and carbon reduction. With this being an evolving programme it is not possible to identify all of the exact projects that will be undertaken with the 5 year timeframe. A number of feasibility studies are ongoing and several enabling projects are underway that are assisting in the delivery of this Plan. Below are the key themes that have been identified through a number of workshops as key strategic areas of work over the next five years to deliver carbon and financial savings in the short and medium term.

Improvements to building fabric and insulation

The complexity, age and construction of our buildings result in differing thermal properties, with some being very poor at retaining heat. As such a major element of the Plan will be to improve their thermal performance, thereby reducing the heat and carbon demands. The extent of the works required will vary from building to building and will include elements such as glazing upgrades, installation of roof and cavity insulation and possible external cladding where no cavities exist.

Laboratories

Our research-led agenda results in significant amounts of energy intensive research laboratory equipment being used across the estate. The Plan will complement such activities, enabling them to continue but with a minimal carbon demand. One of the most significant energy users within the laboratory environment are fume cupboards, with some 630 installed across the estate. 380 of these devices are linked to our Building Management System and data from this shows that in the region of 50% of fume cupboards are left running 24/7 at a cost of £1,650 per fume cupboard per year, each creating 14 tonnes of CO_2. There will be a number of situations that necessitate some fume cupboards requiring to be left on including where dedicated storage for chemicals is necessary. Significant financial and carbon savings will be achieved through retrofitting Variable Air Velocity devices to the existing systems, and operating fume cupboards only when required. Awareness raising, training and education of laboratory staff will be provided to deliver maximum savings in line with more efficient operational use. In addition further work will be done to quantify opportunities of heat recovery from fume cupboard exhausts.

Major equipment upgrades

Significant savings will be achieved through upgrades to chillers, fridges, pumps, drives, motors and their controls. There are a number of inefficient pieces of equipment that are coming to the end of their useful lives; these will be replaced over the next few years with more efficient equipment. This will enable greater efficiencies in use of energy and allow for greater control so that the use of energy and associated carbon is done in the most effective way.

Behaviour change and awareness

Whilst there are significant savings that can be realised through technical solutions it is essential to seek a change in culture through engagement with staff and students. Awareness and training can result in significant savings, however for such activity to be effective it needs to be sustained and on-going. Work is under preparation for a pilot project with NUS Services limited, the Students' Union and the Environment Team looking into the effectiveness of different marketing and awareness raising methods. Engagement with the student body is essential from day one and this project will enable us to kick start this.

Boiler replacement programme

Upgrading our boiler assets with the most efficient options available will increase the system efficiency and decrease associated carbon emissions generated from combustion. At the same time low carbon technologies will be considered including biomass, using either chip or pellet fuel. The replacement programme will be led by our boiler asset register that will identify the least efficient boilers and those coming to the end of their lives.

Heating energy Strategy

The district heating systems at Sutton Bonington and University Park provide opportunities to consider options for a medium term energy strategy. These include continuation of the existing heating systems and also consider new generation technologies such as combined heat and power (CHP), biomass and ground/lake source heat pumps which would move towards a decentralised system and allow for more localised fuel supplies. Work is underway to fully assess and identify preferred options, with investment likely in years 2 – 5 to deliver energy and CO_2 savings. An initial feasibility study for CHP and partial decentralisation on University Park has identified CO_2 savings c 1,900 tonnes per year.

Lighting upgrades

There will be an ongoing programme of lighting upgrades moving towards a low carbon standard across all of our refurbishment projects. These will include LED systems and controls based on need, daylight and proximity to ensure efficient use.

Renewable energy projects

More effectively utilising renewable energy technologies is an important part of this Plan, both from its carbon and investment paybacks, but perhaps more importantly the message that it gives. These projects tend to be highly visible and start the transition to a low carbon economy. Carbon savings are now able to be delivered to provide improved financial returns on investment, principally as a result of UK government programmes. These include the Renewables Obligation (for large scale electricity generation) and the Feed-in Tariff (for small/medium scale electricity generation) – both deliver significantly improved financial paybacks (typically moving from 25+ years to 10-15 year simple paybacks). Government implementation of the Renewable Heat Obligation in 2011 will result in heat generation from renewables attracting enhanced payments. Relevant schemes include the use of wind projects, photovoltaics (PV), biomass and solar water heating schemes. Technologies such as lake source and ground source heat pumps provide low carbon solutions and further work will be done on assessing how these can be retrofitted to existing systems in a number of locations. There are a number of utilities that are willing to install some technologies for free and provide low cost energy and they recoup their investment through FIT payments - such opportunities may provide the opportunity to install some highly visible projects. A proposed development of three large-scale wind turbines, with an expected planning application in Spring 2011, will contribute significantly to the target and generate up to 7.5 MW of carbon free electricity, with an equivalent CO_2 saving of c. 7000 tonnes per year.

Green IT

ICT in UK higher education has a large carbon footprint. It is estimated that in the sector there are one and a half million computers, 250,000 printers and 240,000 servers which collectively produce 500,000 tonnes of CO_2 a year. Work has been undertaken to date in conjunction with Information Services, reducing the energy demand of computers through the procurement process, power management and shutdown, server virtualisation and moving away from printers and photocopiers to MFDs. It is important that the widespread roll-out of any new technologies is supported with a comprehensive marketing and awareness campaign to ensure maximum buy in and carbon savings.

Lower energy strategies for activities within buildings

Our intensive research and teaching activities in many of the Science, Engineering and Medicine faculty buildings result in significantly increased building energy consumption and CO_2 emissions, compared to typical BREEAM benchmark figures of 90-130 kg CO_2/m^2 (see Appendix 2) even in new energy efficient building designs. Analysis of these situations suggests that there is scope with appropriate investment for substituting current operational practice and large scale high energy consumption equipment with alternative strategies for delivering the necessary research and teaching outputs with much reduced carbon emissions.

This will be a medium to longer term objective and is expected to contribute significantly to our CO_2 target reductions in 2015-2020.

Carbon Saving Projects

Since the late 1990s, the University has been committed to sustainability and low energy/carbon developments demonstrating new technologies and achieving significant performance improvements to the requirements of building regulations. A number of projects have been recognised with national and international awards.

Particularly noteworthy are:

- Jubilee Campus – phased development expanded to 65 acres since 1999. An exemplar of brownfield regeneration and low carbon building design and environmental excellence.

- Sustainable Research Building – low carbon design achieving less than 50 kg CO_2/m^2.

- Creative Dwellings – a cluster of 5 experimental houses each demonstrating a different combination of new materials and technologies to produce low carbon housing.

- Centre for Sustainable Energy Technologies, China Campus – a zero energy research building.

- Energy Technologies Building, Jubilee Campus – for completion in 2011 – to be one of the first BREEAM outstanding buildings in the HE sector.

Our investments programme in existing buildings has maintained a focus on energy/carbon reduction; where opportunities have arisen, these have included the following:

- Double glazing insulation
- BMS local and centralised heating and lighting controls
- Low energy light fittings
- High efficiency boilers and water heaters.

To further support our carbon investment in 2009 we secured a revolving investment fund of £375k from Salix finance/HEFCE, to date approximately £260k worth of carbon saving projects have been realised with financial savings being re-circulated to fund new projects.

2010 – 2012 Projects

Below is an overview of the indicative scope of projects planned for 2010/2012 including an indication of the scale of investment required, the potential carbon saving and the payback in years. It is assumed that 60% would be realised within this timeframe.

Building fabric and insulation projects

Investment – £730,000 Carbon Savings – 300 tonnes/yr Payback Period 5 – 10 years

These projects will be a combination of roofing, cavity wall and glazing upgrades. More than 30 buildings – equating to 30,000 m^2 of roof space - have been identified requiring roofs being insulated to a thickness of 300mm insulation, including ten Halls of Residence. To maximise the short term benefit it would be necessary to progress installation before the start of the main heating seasons. Medium term there is the potential for external cladding of some buildings without wall cavities to both improve their thermal performance and appearance. The ongoing program of replacement of single glazing systems will continue and be carried out in conjunction with the cavity insulation where appropriate.

Awareness

Investment – £75,000 Carbon Savings – 520 tonnes/yr Payback Period 1 – 2 years

Awareness raising has been proven to result in savings, indeed our own energy campaign in November 2008 resulted in £30,000 savings in a single month. To maximise the energy and carbon saving a dedicated resource - an intern, placement or new staff member - will be required including a budget for events, materials and training. Savings have been assessed using a 1.25% reduction in gas usage due to staff and student behaviour change.

Fume cupboards

Investment – £120,000 Carbon Savings – 226 tonnes/yr Payback Period 5 – 8 years

Clear opportunities exist for significant savings through improvements to the management and technical operation of fume cupboards. Pilot work with Chemistry, the Estate Office and the Safety Office is assessing the reduction of face air velocities, awareness raising and improving fume cupboard controls. Moving from current 24/7 operation to working day operation results in the region of 75% cost savings, with associated carbon savings of 226 tonnes for the first phase of this project. These would be assessed for roll-out across all University laboratories in years 2 and 3.

Lighting upgrades

Investment – £75,000 Carbon Savings – 170 tonnes/yr Payback Period 2 – 10 years

Improvements to and upgrades of lighting will continue to be carried out across the University, particularly in spaces that are currently not controlled and in many instances left switched on. LED technologies are being evaluated in corridors, lavatories and outside lighting areas of University buildings. A number of projects will be installed to demonstrate the technology and more will be installed as further cost effective advances are made.

Building energy/carbon management

Investment –£125,000 Carbon Savings – 746 tonnes/yr Payback Period 3 – 5 years

Improvements to the control capabilities of pumps, drives and motors will enable better management of energy and carbon production. Improvements to Building Management Systems controls will enable incremental savings to be made. These will often be carried out in conjunction with associated remedial building fabric work to deliver required temperature controls. Improving the thermal performance of buildings will enable us to consider reducing our heating temperature initially by 1 degree Celsius which would result in a c. 5% reduction in gas usage. This would result in significant CO_2 savings of c. 606 tonnes.

Renewable energy projects

Investment – University £200,000 Carbon Savings – 25 tonnes/yr Payback Period 8 – 12 years

The introduction of the Feed-in tariffs (FIT) has resulted in greatly improved financial paybacks of small/medium scale renewable electricity projects. It is important that clear messages about the overall contribution are communicated for these very visible initiatives, as the investments in on-site renewable technologies only give modest carbon savings. Energy utilities have confirmed their interest in partnering with the University to install photovoltaic (PV) systems at scale. These could be internally and/or externally financed. High visibility systems of this type also have the additional benefit of improving staff and student buy-in to the Plan.

Summary of Projects 2010 – 2012

Project areas	Investment	Carbon savings – tonnes
Building fabric and insulation	£730,000	300
Awareness and engagement	£75,000	520
Fume cupboards	£120,000	226
Equipment upgrades	£125,000	746
Renewables	£200,000	25
Lighting	£75,000	170
Total	£1,325,000	1987
Target for 2012 @ 60%	**£795,000**	**1,192 tonnes /yr**

Carbon Management Plan summary 2010-2015

Below is a summary table of the Action plan to 2015 highlighting investment and Carbon savings – a list of identified pipeline projects for 2012 – 2015 is given in Appendix 3.

Area	**Indicative investment**	**Carbon savings - tonnes /yr**
2010 – 2012 projects @ 60%	£795,000	1200
2012 – 2015 projects pro-rata	£1.2 million	1800
Wind Turbine development	£8 – 10 million	7000
Large scale renewables	£ 2 million	250
Heating energy strategy	£3 million	2000
Green IT	tbc	2000
Building activities – lower energy strategies	tbc	2750
Total		**17,000**

Table 4: Summary of five year Action Plan to 2015

Appendix 1

University Carbon Baselines - detailed breakdown of components

Year	Oil		Gas		Electricity		Coal		Transport	TOTAL
	m^3	t CO_2	MWh	t CO_2	MWh	t CO_2	MWh	t CO_2	t CO_2	t CO_2
1990/91	4,117	10,466	9,139	1,693	26,798	20,674	4,072	9,514	296	**42,643**
2005/06	0	0	91,488*	76,946	74,105	39,949	0	0	267	**57,163**
Revised 2005/06	0	0	117,800	21,820	74,105	39,949	0	0	267	**62,036**

* Omitted fossil fuel consumption of 26,312 MWh for Medical School.

Appendix 2

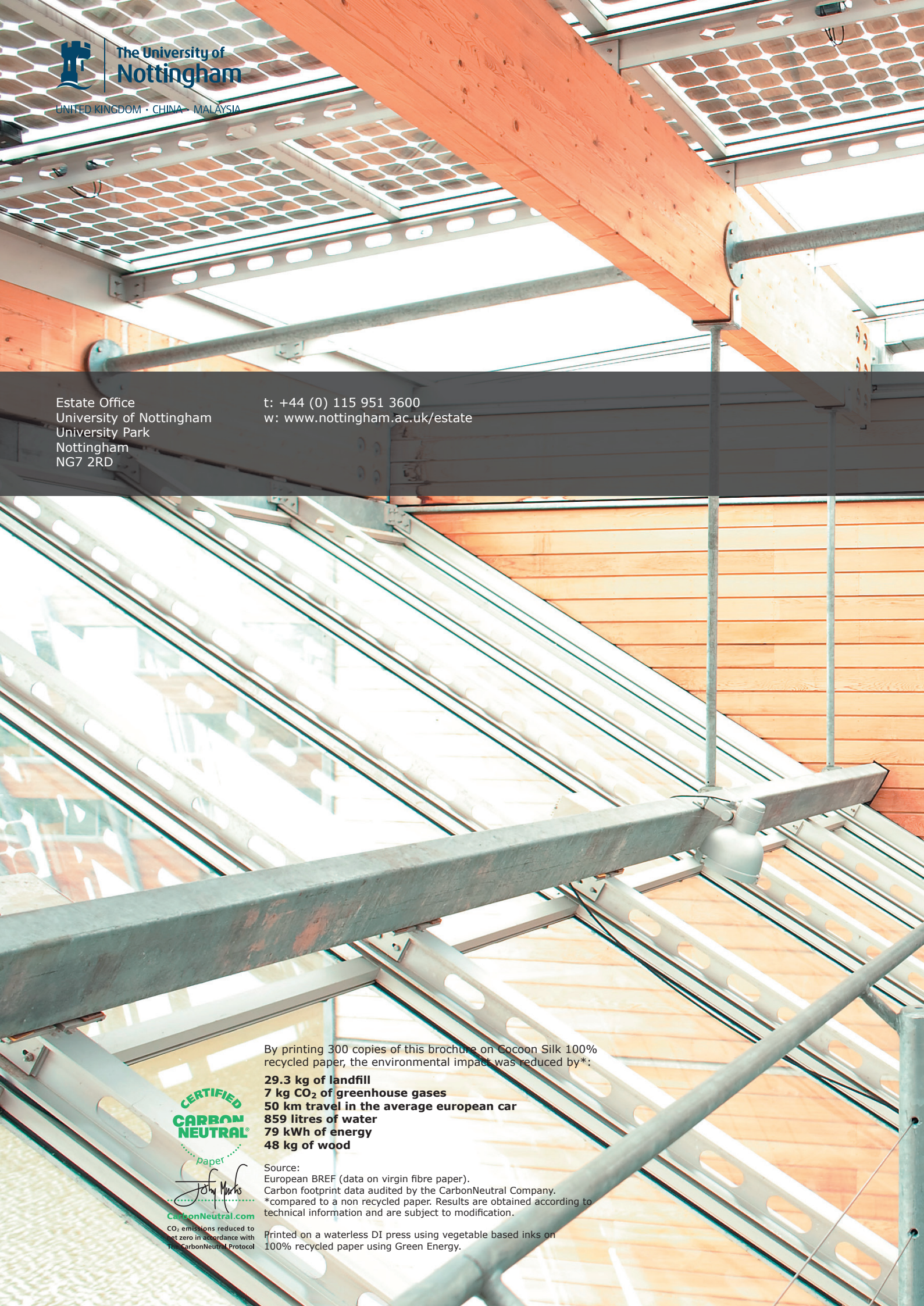
Existing Data: Building/Energy Consumption and Carbon Emissions 2009/10

Building	Building no.	Floor Area (m^2)	Electricity (kWh)	kWh/m^2	$kgCO_2$/m^2	Fossil Fuel (kWh)	kWh/m^2	$kgCO_2$/m^2	Total kWh/m^2	Total $kgCO_2$/m^2
Cripps Computing (South)	1242	1,514	2,651,907	1,752	952	383,549	253	47	2005	999
Plant Sciences	5711	4,934	2,900,000	588	320	2,354,293	477	88	1065	408
Swimming Pool	1571	1,428	507,445	355	193	1,574,296	1102	203	1458	396
Magnetic Resonance Centre	1491	1,867	731,397	392	213	472,976	253	47	645	260
Bio-Molecular Sciences	1353	9,476	3,180,615	336	183	3,586,781	379	70	714	252
Chemistry	1261	13,737	5,023,626	366	199	3,129,520	228	42	594	241
Wolfson Building	1421	3,358	1,031,940	307	167	553,822	165	30	472	198
Boots Science Building	1581	3,951	1,036,600	262	143	1,043,892	264	49	527	191
L3 Chemical Engineering	1311	2,930	739,938	253	137	667,503	228	42	480	179
Clin Sciences (City Hosp) ph1&2	3325	5,430	1,072,677	198	107	1,787,485	329	61	527	168
Maths & Physics	1251	11,284	2,334,394	207	113	2,570,686	228	42	435	154
Biology	1341	6,734	1,247,042	185	101	1,534,119	228	42	413	143
Portland Bldg	1111	15,182	2,543,786	168	91	3,810,866	251	46	419	137
Hallward Library	1171	10,153	1,599,654	158	86	2,313,025	228	42	385	128
Computer Sciences (DCS) & The Atrium	7040	6,254	1,155,000	185	100	887,144	142	26	327	127
The Ameneties Building	7330	2,365	546,184	231	126	0	0	0	231	126
Medical School	3101	75,384	9,571,000	127	69	20,651,614	274	50	401	119
L4 Mechanical Engineering	1321	6,011	844,021	140	76	1,369,407	228	42	368	118
L2 Civil Engineering	1301	5,328	710,254	133	73	1,213,808	228	42	361	114
Psychology	1332	6,727	869,420	129	70	1,532,524	228	42	357	112
Tower	1271	7,683	987,230	128	70	1,750,317	228	42	356	112
Pharmacy	1333	4,659	591,598	127	69	1,061,399	228	42	355	111
D H Lawrence Lakeside Pavilion	1631	1,791	239,440	134	73	365,375	204	38	338	110
King's Meadow Campus	6901	22,211	3,310,488	149	81	3,201,744	144	27	293	108
George Green Library	1281	3,726	420,765	113	61	848,846	228	42	341	103
Business School South (new)	7080	5,338	851,472	160	87	446,454	84	15	243	102
Lenton & Wortley Hall	2141	5,783	491,332	85	46	1,731,895	299	55	384	101
Main Building (SB)	5011	4,505	805,748	179	97	85,684	19	3	198	101
Derby Medical School	3561	6,924	855,641	124	67	1,203,031	174	32	297	99
Law & Social Sciences Building	1151	8,084	840,331	104	57	1,841,672	228	42	332	98
Arts Centre & School of Music	1501	3,420	431,582	126	69	531,689	155	29	282	97
Sports Centre, Main Campus	1221	5,073	678,116	134	73	653,719	129	24	263	96
Hugh Stewart Hall	2181	9,255	622,232	67	37	2,867,795	310	57	377	94
Sir Clive Granger Bldg	1201	6,585	598,822	91	49	1,500,174	228	42	319	91
Veterinary School	5721	7,520	650,000	86	47	1,770,501	235	43	322	90
Willoughby Hall	2211	6,603	558,119	85	46	1,554,629	235	43	320	89
Coates Building (T2)	1292	8,943	767,644	86	47	2,037,366	228	42	314	89
International House	7320	3,400	542,339	160	87	0	0	0	160	87
Sir Colin Campbell Building	7340	4,534	714,263	158	86	0	0	0	158	86
Pope Building (T2)	1291	4,944	385,252	78	42	1,126,327	228	42	306	84
Cavendish Hall	2111	5,025	353,021	70	38	1,117,667	222	41	293	79
Jesse Boot Conference Centre	1481	3,946	233,270	59	32	986,720	250	46	309	78
Lincoln Hall	2151	6,502	359,723	55	30	1,552,050	239	44	294	74
Trent Building	1101	13,326	584,193	44	24	3,580,327	269	49	313	73
Business School North (SMF)	7020	3,936	403,088	102	56	373,084	95	17	197	73
Archaeology & Classics (OEB)	1141	4,826	265,113	55	30	1,099,444	228	42	283	72
Jubilee Sports Centre	7301	2,467	205,894	83	45	331,380	134	25	218	70
Sherwood Hall	2200	8,243	433,286	53	29	1,770,641	215	40	267	68
North Laboratory	5091	3,626	451,035	124	68	728	0	0	125	68
Cripps Hall	2171	11,449	499,016	44	24	2,605,179	228	42	271	66
Nottingham Geospatial Building	7350	2,994	290,000	97	53	202,913	68	12	165	65
Dearing Building (FOE)	7050	5,977	547,569	92	50	495,297	83	15	174	65
Newark Hall	7130	8,082	537,651	67	36	1,230,853	152	28	219	64
Rutland Hall	2191	7,157	309,429	43	24	1,537,363	215	40	258	63
Nightingale Hall	2161	6,456	202,027	31	17	1,537,905	238	44	270	61
The Exchange (CTF)	7030	3,984	288,645	72	39	453,988	114	21	186	60
Southwell Hall	7120	4,035	232,800	58	31	626,018	155	29	213	60
Derby Hall	2121	9,821	371,044	38	21	2,098,898	214	39	251	60
Florence Boot Hall	2131	7,931	421,683	53	29	1,326,365	167	31	220	60
Sustainable Research Building	1436	1,693	102,746	61	33	85,889	51	9	111	42
Lenton Grove (History)	1211	1,481	46,447	31	17	164,156	111	20	142	37

Appendix 3

2010-2015 Pipeline Carbon Reduction Projects -Suggestions for Further Assessment

- Avoid switch start light fittings - update design manual
- Cavity wall and roof insulation
- Coates building - heating improvements
- Better space utilisation (e.g. can some halls close in the summer?)
- Control/refurbishment of fume cupboards, more stringent policy on use, to prevent all night running for chemical storage
- Decentralised heating, CHP, biomass at UP and SB
- Define heating season for the whole University
- Develop awareness programme and educate staff & students
- Develop heating & cooling policy – consider reduction in temperature settings
- Improved lighting controls - dimmable, daylight control
- Install Voltage Optimisation
- Maximise day lighting - monodraft type technology
- Medical School - replace expensive & inefficient absorption machines with elec chillers
- Target carbon specification to be produced for refurbishment
- Minimum specification for lighting during refurbishments, to include lighting controls
- Plant room surveys looking at insulation, controls, VSDs
- Potential to reduce street illumination at night (i.e. time changes, fittings)
- Programme for new BMS space sensors in buildings to gain better control
- Photo Voltaic (PV) installations for academic and residential buildings
- Re-clad and fit new glazing in 60s & 70s buildings (e.g. Sir Clive Granger, L2/3/4, North Lab, George Green Library)
- Review controls within NHS facilities
- Review use of solar shading / solar film
- Small-scale CHP for major buildings such as Swimming Pool, Halls etc
- Solar hot water heating in halls
- Timers on water heaters / vending machines (make this a default on installation)
- Upgrade radiators – renew or fit temperature restrictor valves



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