Carbon Management Plan
Annual Report 2014/15

Carbon Management

Contents

Executive Summary

This is the University's 2014/15 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 over the past 12 months[1].

The University's CMP[2] was approved in December 2010 and includes targets for reductions in emissions of CO_2 from energy consumption. It identifies the principal areas of energy use and our investment programmes to improve energy efficiency, reduce consumption and generate energy from lower carbon and renewable energy sources.

Our reported Scope 1 and 2 Carbon dioxide emissions for 2014/15 have showed a decrease of 2.9%. Emissions for year 2014/15 are 57,596 t CO2 a decrease from 2013/14 of 1,736 t and down 10,392 t from 2009/10 baseline of 67,998 t CO2.

The fifth year's programme invested £2.8m in projects across all areas of the CMP, with predicted annual savings totalling £433k and 2,021 tonnes of CO_2. Since 2010 our CMP has invested in excess of £10.8m, with estimated annual savings in the region of 11,000 tonnes of CO_2.

This year investments have covered a range of areas, including plant replacement (boilers and chillers), replacement LED lighting upgrades , and the continuation of insulation and double glazing projects along with energy saving fume cupboard upgrades. Targeted action at the Medical School continues with projects to replace the majority of the large centralised chilled water production and reduce the ventilation losses through service void areas between the user floors. Significant work has commenced at Sutton Bonington to expand campus wide low carbon energy solutions including a mixed renewable generation . The project to install a 800kW Combined heat and power (CHP) is currently nearing completion ready for operation as the winter period approaches. The 500kW wind turbine project has been submitted for planning with a decision expected November 2015.

Since the publication of the CMP in 2010 the University has continued to grow and the carbon associated with the University's development exceeded its projected additional carbon of 3,000 tonnes by the end of 2012. This can be explained by the impact of increased activity especially in areas of energy intensive research.

Over the remaining life of this plan the University will continue to significantly expand its capital program to 2020 along with continued expansion in energy intensive research activity. The CMP will therefore continue to invest in the existing estate and new build projects continue to meet the very highest sustainability standards. As a result, future projects will seek to achieve significant carbon reduction targets, realise financial benefits and improve system/ infrastructure resilience with an associated delivery plan to ensure it is well aligned with the University's Strategy 2020.

[1] The scope of our plan includes all of the University's UK assets, with the exception of the University of Nottingham Innovation Park and East Midlands Conference Centre ltd. assets which are excluded from the reported figures.

[2] www.nottingham.ac.uk/about/values/environment/carbonmanagement.aspx

1 Introduction

This is the University's fifth Carbon Management Plan (CMP) annual report for 2014/15. 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 fifth year's programme has invested £2.8 m in projects across all areas of the CMP, with predicted annual savings totalling £433k and 2,021 tonnes of CO_2. So far the CMP has resulted in investments in excess of £10.8m, with estimated annual savings of 11,057 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.

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 5 year investment programme to be implemented to deliver environmental performance improvements and carbon & financial savings[3]. The CMP targets and objectives included in the University Plan 2010-15 are as follows:

	Baseline 2009/10	Target 2014/15
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 plus offsetting any predicted increased carbon emissions from activity and premises growth. 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.

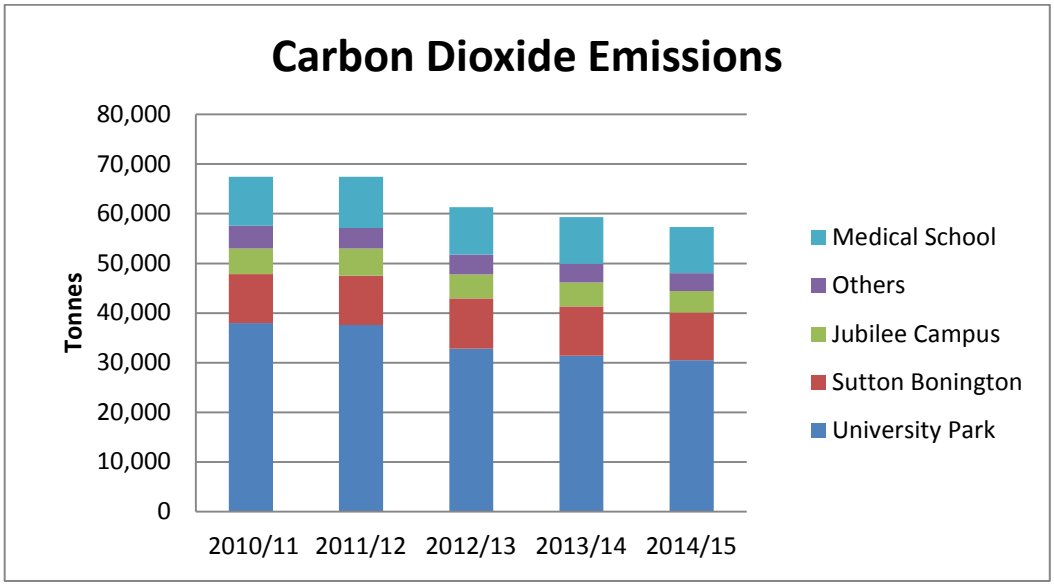
We will continue to priorities the most energy intensive buildings such as the Medical school while developing energy strategies for each campus with the overall aim of reducing carbon emissions, improving financial sustainability, system resilience and student experience and Where possible deliver incoming generation via government feed in tariffs

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

3 Performance achieved

3.1 Carbon dioxide emissions (Scope 1 and 2)

In 2014/15 carbon dioxide emissions fell by 1,736 tonnes following continued investment in carbon projects as detailed in section 4. However these were partly offset by the colder weather which increased demand for heating from natural gas. The National Grid has however reduced its CO_2 emissions associated with power generation through the increasing proportion of renewable energy and gas fired power stations supplying the grid. This year the power generation mix shift has significantly helped our overall carbon performance across all campuses as almost two thirds of our CO2 emissions are associated with electricity use.



CO2 Emission factor [4]	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Electricity Kg/kWh	0.542	0.541	0.541	0.484	0.494	0.462
Natural Gas Kg/kWh	0.205	0.204	0.204	0.184	0.185	0.184

CO2 Emissions (t)							Change
	2009/10	**2010/11**	**2011/12**	**2012/13**	**2013/14**	**2014/15**	**2013/14to2014/15**
University Park	39,194	38,007	37,578	32,814	31,424	30,490	-3.0
Sutton Bonington	9,854	9,804	9,964	10,103	9,876	9,637	-2.4
Jubilee Campus	4,949	5,192	5,430	4,892	4,855	4,572	-5.8
Others	4,568	4,587	4,161	3,994	3,731	3,612	-3.2
Medical School	10,061	9,865	10,289	9,519	9,446	9,285	-1.7
Total	**68,626**	**67,455**	**67,422**	**61,322**	**59,332**	**57,596**	-2.9

[4] Our emission factor for grid consumed electricity includes Scope 1 and 2 emissions and does not include scope 3, i.e. those associated with transmission and distribution losses and are obtained from DEFRA.

3.2 Electricity

Electricity consumption increased 0.5% over the last 12months compared to last year. Floor area increased by only 0.6% over the same period, but several other buildings were completing their first full year of occupancy, meaning that underlying electricity consumption has now effectively levelled off.

3.3 Natural Gas

Consumption of fossil fuels increased by 4%, partly due to the colder weather over the 2014/15 winter/ spring period along with total floor area increase by 0.6% in the year. The Medical School continues to see reduction in carbon emissions following investment in chilled water plant, steam controls and ventilation losses etc. These efforts are continuing to be concentrated on the Medical School and it is to be expected that we will see significant reductions in steam consumption over the next year.

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 2014/15 Energy Report.

3.4 Targets

At the mid-point of our Carbon Management Plan our 5 year target required annual CO_2 was 54,000 tonnes, a reduction of 14,000 tonnes plus an additional 3000 tonnes to offset impact of new buildings. Total programme savings end 2014/15 are now stand at 11,057 t CO2 per annum from 2009/10.

Since the publication of the CMP in 2010 the University has exceeded its estimated growth plan, however carbon emissions have reduced by 10,392 t CO_2. Once again the success or failure of the National grid to reduce it CO2 emissions associated with power generation will have a significant influence on our carbon performance. The challenge over the period to 2020 will be to continue to identify and implement carbon reduction initiatives to achieve absolute reductions in emissions offsetting continued growth in new buildings and increased intensive energy consumption from research.

4 Carbon projects

4.1 Carbon Management Plan projects

A summary of carbon saving projects installed in 2014/15 together with totals for investment in previous years 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	783,000	9,778	77
Laboratories: Continuation of Fume Cupboard works	Upgrade of fume cupboard controls, inverters and upgrade of fume cupboards with VAV.	105,000	28,162	172
Combined heat and power plant	New 800kW of CHP plant for Sutton Bonington Campus	1,320,000	272,000	1,250
Boiler Replacements and controls	Replacement of old inefficient boilers for more efficient models in halls of residence, along with improved controls and BMS sensors	196,000	8,413	53
Pump Upgrades and thermal covers	Installation of inverters to existing pumps and thermal covers in plant rooms.	36,300	7,754	56
Ventilation and Cooling	Instillation of more efficient ventilation systems and the installation of new steam/cooling control systems for the Medical School	370,000	105,390	387
Lighting upgrades	LED replacement lighting in Medical school and Sir Clive granger	53,091	3,687	26
Total for 2014/15		2,863,391	433,325	2,021
Total for 2013/14		2,136,070	339,793	1,390
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	666,424	4,096
Total for 5 years		**10,805,372**	**1,576,165**	**11,057**

4.2 Project overview

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

Improving the thermal performance of our buildings has continued 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 to deliver investment in the laboratory fume cupboard efficiency programme with further works to reduce fan speed with full variable speed extracts 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.

The first large scale CMP project comes on line this Autumn with the installation of the Combined heat and power plant at the main boiler house at Sutton Bonington.

The Medical School continues to receive investment with additional large high efficiency chiller unit due to be operational for next spring and extensive work on reducing uncontrolled heat loss from the service void areas between each user floor.

4.3 Renewable energy projects

Small and medium scale renewable energy projects are financially supported by UK legislation through initiatives such as 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 University's renewable energy generation in the last 12 months.

Building	Technology	Annual Production (kWh)
Dearing	PV	7,570
Business School North	PV	13,842
Computer Sciences	PV	6,400
Derby Hall	PV	52,383
Lincoln Hall	PV	52,036
Si Yuan Chinese Studies	PV	8,909
Aerospace Technology	PV	11,471
Environmental Education Centre	PV	10,500
Sustainable Research Building	PV	7,500
Veterinary School	PV	128,816
Total		**299,427**
Si Yuan Chinese Studies	Solar thermal	2,200
Geospatial	Biomass	54,730
BioEnergy	Biomass	86,990
Total		**143,920**

These installations have saved 165 tonnes of Carbon and have generated in excess of £58k in revenue through the Feed in Tariff and Renewable Heat Incentive. These tariffs are currently under review and are likely to see significant reduction for all new schemes, however tariffs for existing arrangements as above are fixed.

4.4 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 well underway and the current proposal is for a mixed blend of established technologies utilising renewable electrical generation schemes, photo voltaic (PV) array and wind turbine technology which now benefit from various recent government feed in tariffs which further incentivise their use. Further details and update is shown below.

145kW (peak) Roof mounted PV Array (Now operational for 1 year)

Roof mounted array for the clinical wing of the Vet school, totals approx. 1000m2 Now operational for 12 months with annual yield in the first year of 128,816kWh based on the latest emissions data this has saved 54 tonnes of CO_2 and achieved a cost saving of £25K which includes the government feed in tariff.

800kWe Gas fired CHP (Nearing completion)

2x400 kWe CHP units that will also produce 986 kW of thermal energy in the form of Low Pressure Hot Water (LPHW) at nominal flow and return temperatures of 80/70°C utilising the existing site distribution mains that serve over 50% of the existing building stock. The CHP plant will 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 6500hrs per year, an estimated 5139MWh electrical output and 6412MWh thermal output. This would result in net savings of approximately 1250 tonnes CO_2 and energy cost saving of £272k per annum.

500kW (peak) Wind Turbine (Planning)

A 500kW wind turbine situated near the dairy farm would generate an estimated annual output of 1,633,000kWh with savings of 790tonnes CO_2 based on a mean wind speed of 6.1m/s at the turbine hub height. The annual cost savings, including maintenance, are £323k, comprising £155K in reduced electrical costs and £196K from Feed in tariff (12p/kWh).
We are expecting a decision on the planning application towards the end of November

Main Campus Low Carbon Energy Centre.

Development of a low carbon energy centre to be located in the former CHP building behind the boiler house. This scheme will utilise gas fired CHP plant along with high efficiency gas fired boiler plant with aim of reducing energy cost, carbon emissions while at the same time improving overall system resilience of the district heating system. The system will be designed to fully integrate with future low carbon heat/ energy sources as and when they become available. A Nom 1.5MW CHP along with similar sized boiler plant and additional smaller CHP has been identified has the best 'fit' solution. Fully costed business case is currently being prepared for consideration in autumn/winter 2015.

5 Future carbon management and investment programmes

At this mid-term position, over the coming year we will refresh and update the CMP in order to continue to deliver the depth and range of carbon projects needed to deliver our institutional targets. This will include continuing with plant replacement, glazing and insulation projects and at the same time continue on site with major investments such as the Sutton Bonington low carbon strategy. We will continue to take an evidence-based and targeted approach and further investments in energy and carbon intensive buildings. There will be further investment in the Medical school and a focus on heat delivery to buildings served by the main campus district heat network. An energy strategy to cover the expansion of Jubilee campus is being developed to look at options for low carbon energy sources to possible serve a number of buildings from a common plant room.
Investment over the next 5 years on various carbon reduction programmes is expected to reach £14m and is likely to include large scale building fabric upgrades.

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

- Large and small scale Plant/ infrastructure replacements
- Laboratory efficiency program
- Campus wide low carbon generation strategies
- Staff and student engagement
- Continued improvements to existing building fabric to reduce heat losses
- Review renewable energy strategies following recent reduction in Government feed in tariffs.

6 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.

6.1 Salix Finance

The University continues to utilise its Salix Finance revolving green fund and has used it to invest more than £645K in carbon saving projects to date and will continue to invest these ring fenced savings into further carbon saving projects.

6.2 HEFCE funding

The University submitted proposals valued at £1.6m for the next phase of investment in the Medical school using the HEFCE's Revolving Green Fund to support the carbon management program. The RGF provides recoverable grants to institutions for projects that reduce their emissions. The proposal covers work in Medical school for additional high efficiency chilled water plant, reduced heat loss from the service void areas between each user floor and LED lighting schemes. The bid was successful and the work to the LED's and heat loss from the void areas is now on site with completion this winter, while the replacement chiller plant is due for completion by the spring.

Appendix 1 – Carbon Management Plan projects 2014/15

Project	Location	Technology description	Investment cost (incl VAT) £	Estimated Annual Savings Financial £	CO_2 tonnes	Energy kWh	Payback period (years)	Cost per Tonne of CO2 £
Improvements to building fabric and insulation								
Double Glazing	Pope Building Courtyard	Glazing	95,000	3,172	26	141,000	29.9	3654
	Melton Hall	Glazing	87,000	1,137	9	50,550	76.5	9667
	Chemistry C floor labs and inner quad	Glazing	276,000	1,872	14	74,875	147.4	19714
	Chemistry SE Elevations	Glazing	325,000	3,597	27	143,875	90.4	12037
Lighting upgrades	Medical School F Floor	LED Lighting	39,645	1,738	19	34,760	22.8	2087
	Sir Clive Granger		13,746	1,085	6	13,564	12.7	2291
Boiler Replacement	Hugh Stewart	water heaters	91,000	1,535	8	43,850	59.3	11375
	Lincoln Hall	water heaters	76,000	1,013	6	28,939	75.0	13571
BMS & metering		BMS temperature sensors	29,000	5,865	36	195,500	4.9	806
Plant Room/ roof space services	Various plant rooms	Thermal covers	20,000	5,136	42	228,260		476
Thermal insulation								
Fume Cupbords	CBS C25	Auto sash closuers	15,000	4,695	29.0	172,130	3.2	517
	Chemistry C25/27	Full VAV system	90,000	23,467	143	558,654	3.8	629
Pump inverter drives	Medical School VT heating Circuit	Inverter variable speed	9,000	879	9	17,594	10.2	1000
	Vets School chilled water	Inverter variable speed	7,000	1,739	11	21,738	4.0	654
Misc	Medical Sch Voids B and C	Controlled Ventilation	328,000	55,390	187	1,132,000	5.9	1754
	Medical Sch BMSU Humidity control	BMS controls	15000	7,500	30	150,000	2.0	500
	Medical Sch passing steam valves	Valves/BMS controls	27,000	42,500	170	850,000	0.6	159
SB low carbon projects		CHP	1,320,000	272,000	1,250.0	n/a	4.9	1056
	Summary	**YTD £**	**2,863,391**	**434,320**	**2,021**		**32.6**	**1417**
		-	-					
SB low carbon projects	Dairy farm (Planning decision due November)	Wind Turbine	1,782,000	328,000	807.0	1,633,000	5.4	2208

The University of Nottingham

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