



Carbon Management Plan Annual Report 2013/14

University of Nottingham

Annual Report 2013/14 Carbon Management

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Executive Summary

This is the University's 2013/14 Carbon Management Plan (CMP) annual report. It provides details on progress achieved and performance improvements made in reducing emissions of carbon dioxide (CO₂) against University targets over the past 12 months¹.

The University's CMP² was approved in December 2010 and includes targets for reductions in emissions of CO₂ 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 Scope 1 and 2 Carbon dioxide emissions for 2013/14 have showed a decrease of 3.2%. Emissions for year 2013/14 are 59,332 t CO₂ a decrease from 2012/13 of 1,990 t and down 8,666 t from 2009/10 baseline of 67,998 t CO₂.

The fourth year's programme invested £2.1m in projects across all areas of the CMP, with predicted annual savings totalling £340k and 1,390 tonnes of CO₂. Since 2010 our CMP has invested in excess of £7.9m, with annual savings in the region of 9,036 tonnes of CO₂.

This year's investments have covered a range of areas, including plant replacement (boilers and chillers), lighting upgrades including main campus LED street lighting project, and the continuation of insulation and double glazing projects. There has also been targeted action at the Medical School with projects to replace parts of the large centralised chilled water production and reduce the ventilation losses through service void areas between the user floors. Significant work has continued to explore campus wide low carbon energy solutions including a mixed renewable generation solution for Sutton Bonington. A large Photovoltaic (PV) array has been installed on the Vet School Clinical wing and is now operational. A project to install a 800kW Combined heat and power (CHP) scheme has been tendered and is waiting for final approval before orders are placed. A 500kW wind turbine project has been scoped and the University will submit it for planning permission with a practical solution to mitigate any impacts on East Midlands Airport.

Since the publication of the CMP in 2010 the University has exceeded its growth plan and the carbon associated with the Universities 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 and the 12 month lag on reported energy reduction from carbon management projects.

Over the remaining life of this plan the University will continue to expand its capital program with a possible additional 100,000m² of new build floor area by 2020 along with continued expansion in energy intensive research activity. The CMP will therefore need to continue to invest in the existing estate and to ensure new build projects continue to meet the very highest sustainability standards. As a result, future projects will seek to achieve significant carbon reduction targets and realise financial benefits. However the inability to deliver the Grove farm wind turbine project and higher than anticipated growth in energy intensive active mean the target CO₂ reductions from the 2010 CMP may now be unrealistic. . The CMP is in the process of being reviewed and refreshed to re-establish both the targets and the 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 fourth Carbon Management Plan (CMP) annual report 2013/14. It provides details on progress achieved and performance improvements made against targets.

The CMP was approved in December 2010, with target CO₂ reductions to be delivered against timescales. The fourth year's programme has invested £2.1 m in projects across all areas of the CMP, with predicted annual savings totalling £340k and 1,390 tonnes of CO₂. So far the CMP has resulted in investments in excess of £7.9m, with annual savings of 9,036 tonnes of CO₂.

The report provides an update on energy and carbon dioxide (CO₂) emissions arising from Scope 1 and 2 sources, CO₂ reduction projects approved and installed, CO₂ savings, financial performance and the programmes of work planned for the next 12 months. Over the coming year further work will be undertaken to include the measuring of our scope 3 emissions as part of a wider refresh of the carbon management plan.

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 CO₂ 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. CO₂ reductions from travel, procurement and waste (Scope 3) are not included within the scope of this report.

The CMP provides a baseline of CO₂ 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 savings³. 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

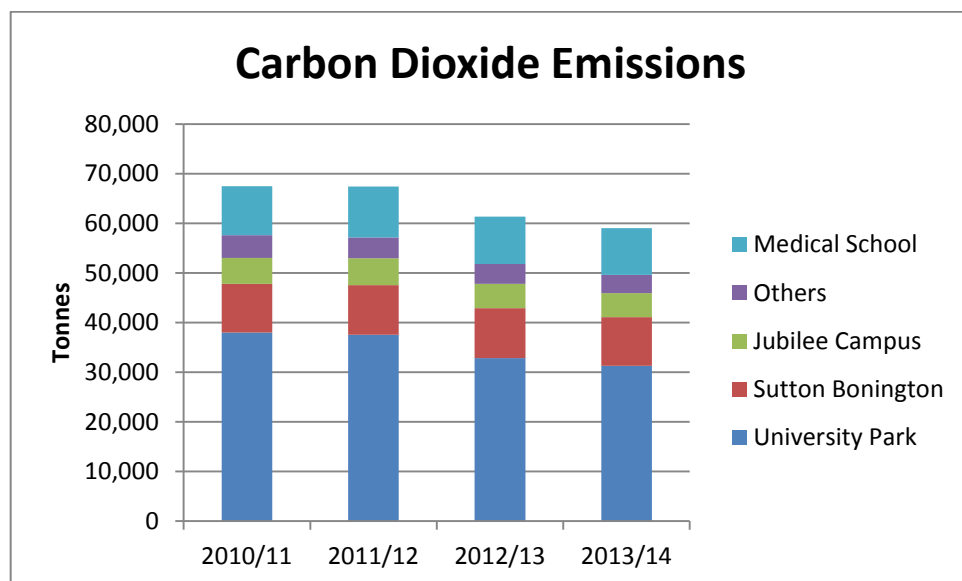
These represent reductions from the 2009/10 usage of 15% on energy and 20% on CO₂ emissions by 2014/15. The targets require average annual reductions in energy consumption of 6GWh and CO₂ emissions of 2,800 tonnes plus offsetting any predicted increased carbon emissions from activity and premises growth. 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.

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

3 Performance achieved

3.1 Carbon dioxide emissions (Scope 1 and 2)

In 2013/14 carbon dioxide emissions fell by 1,990 tonnes following continued investment in carbon projects and the warmer weather which reduced demand for heating from natural gas. Going forward the success or failure of the National Grid to reduce its CO₂ emissions associated with power generation will have a significant influence on our carbon performance.



CO2 Emission Factors ⁴		2011/12	2012/13	2013/14
2010/11				
Electricity Kg/kWh	0.541	0.541	0.48357	0.49426
Gas Kg/kwh	0.204	0.204	0.18404	0.18497

CO2 Emissions	2010/11	2011/12	2012/13	2013/14
University Park	38,007	37,578	32,814	31,424
Sutton Bonington	9,804	9,964	10,103	9,876
Jubilee Campus	5,192	5,430	4,892	4,855
Others	4,587	4,161	3,994	3,731
Medical School	9,865	10,289	9,519	9,446
Total	67,455	67,422	61,322	59,332

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. These are consistent with the methodology reported to the HESA Estate Management Records methodology (<https://www.hesa.ac.uk/>).

3.2 Electricity

Electricity consumption edged up another 1% year on year. Floor area increased by only 0.5% over the period, but several other buildings were completing their first full year of occupancy, meaning that underlying electricity consumption has now effectively levelled off.

The largest percentage increase was at Jubilee Campus, where the new HV supply feeding The Energy Technologies Building / Aerospace Technologies / Institute of Mental Health / Romax Building showed an increase of 376MWh, almost half of the total overall increase seen for all sites. However as these buildings form part of the University on Nottingham Innovation Park they are not included in the above CO₂ figures.

3.3 Fossil Fuels

Consumption of fossil fuels dropped by 13%, partly due to the extremely mild weather over the 2013/14 winter season although total floor area did increase by 0.5% in the year. The Medical School, which saw a relatively low drop in carbon emissions (5.6%) reinforces our need to invest more in this particular facility in the future. A significant portion of this energy usage is actually steam used for cooling purposes, which would be unaffected or even adversely affected by the warmer weather. Efforts are being concentrated on the Medical School, and it is to be expected that we expect to see significant reductions in energy usage over the next couple of years.

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 2013/14 Energy Report.

3.4 Targets

At the mid-point of our Carbon Management Plan our 5 year target required annual CO₂ was 54,000 tonnes, a reduction of 14,000 tonnes plus an additional 3000 tonnes to offset impact of new buildings. This programme included a reduction in emissions from the proposed Grove Farm wind farm of 7,000 tonnes per year. Programme savings end 2013/14 are now at 9,036 t CO₂ per annum from 2009/10 compared to the 5 year target of 10,000 t CO₂ excluding the wind turbine project.

Since the publication of the CMP in 2010 the University has exceeded its estimated activity and growth plan and therefore carbon emissions reduced by 8,668 t CO₂. 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 2013/14 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	739,500	25,844	125
Laboratories: Continuation of Fume Cupboard works	Upgrade of fume cupboard controls, inverters and upgrade of fume cupboards with VAV.	115,000	29,763	190
Chiller Upgrades	New high efficiency Chiller for Medical school to part replace old equipment	190,000	45,600	145
Boiler Replacements and controls	Replacement of old inefficient boilers for more efficient models in halls of residence, program of improved building sensor controls	399,730	66,393	355
Pump Upgrades	Installation on inverters, replacement pumps and software modifications	37,840	12,470	61
Ventilation and Cooling	Instillation of more efficient ventilation systems and the installation of new steam/cooling control systems for the Medical School	266,000	118,600	371
Lighting upgrades	LED replacement lighting schemes	165,000	15,116	73
PV Array	1000m2 Roof top Array at Sutton Bonington	223,000	26,000	69
Total for 2013/14		2,136,070	339,793	1390
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 4 years		7,941,981	1,576,165	9,036

4.2 Project summary

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 continues to be a high priority 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.

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.

The Medical School has seen Investment in a large high efficiency chiller unit 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	6,641
Business School North	PV	14,000
Computer Sciences	PV	7,500
Derby Hall	PV	54,460
Lincoln Hall	PV	55,197
Si Yuan Chinese Studies	PV	8,899
Aerospace Technology	PV	11,435
Environmental Education Centre	PV	12,000
Sustainable Research Building	PV	8,000
Total		178,132
Rutland & Sherwood Hall	Solar thermal	13,120
Si Yuan Chinese Studies	Solar thermal	2,300
Geospatial	Biomass	60,000
BioEnergy	Biomass	150,000
Total		255,420

These installations have saved 142 tonnes of Carbon and have generated in excess of £43k in revenue through the Feed in Tariff and Renewable Heat Incentive.

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 the one most developed 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 below.

145kW (peak) Roof mounted PV Array (Now completed)

Roof mounted option for the clinical wing of the Vets school, totals approx. 1000m² and will generate an estimated electrical annual output of 127,115kWh with saving of 69 tonnes CO₂.

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 (Tendered and waiting for final approval)

800 kWe CHP unit 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. 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 6500hrs per year, an estimated 5139MWh electrical output and 6412MWh thermal output. This would result in net savings of approximately 1256 tonnes CO₂ and energy cost saving including maintenance of £272k per annum.

500kW (peak) Wind Turbine (On hold until issues with EMA radar mitigation equipment are resolved)

A 500kW wind turbine situated near the dairy farm would generate an estimated annual output of 1,633,000kWh with savings of 790tonnes CO₂ 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).

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.

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

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. Investments this year have included the work .

6.2 HEFCE funding

The University has 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 outcome of this bid is expected to be known in early 2015.

Appendix 1 – Carbon Management Plan projects 2013/14

Project	Location	Technology description	Investment cost	Estimated Annual Savings		Payback period	Cost per Tonne of CO2
			(incl VAT)	Financial	CO ₂		
			£	£	tonnes	kWh	(years)
Improvements to building fabric and insulation							
Double Glazing	L3 Building	Double Glazing	110,000	1,933	11.6	64,444	56.9
	Coates Building	Double Glazing	180,000	4,000	24.0	133,333	45.0
	Chemistry	Double Glazing	70,000	2,167	13.0	72,220	32.3
Flat roof replacement insulation	L3	Thermal Insulation	110,000	2,880	17.6	96,000	38.2
	Medical school phase 4 and 5	Thermal Insulation	190,000	13,179	48.5	263,585	20.0
	Cripps Health Centre	Thermal Insulation	79,500	1,685	10.7	56,166	47.2
Plant Room/ roof space services	Life Sciences C Floor roof space pipework	Insulation to services pipework	12,000	8,166	49.0	272,220	1.5
Thermal insulation	Various Plant rooms	Insulation Jackets	43,800	13,710	83.0	457,140	3.2
BMS temperature Sensors	Various Buildings on UP	BMS Controls	79,000	25,300	120.0	598,000	3.1
BMS Controls	Medical school	New control system	130,000	11,500	58.0	230,000	11.3
Lighting upgrades	Main Campus Street Lighting	LED	120,000	7,886	38.0	78,800	15.2
	L Buildings high Bay workshop lighting	LED	45,000	7,230	35.0	72,300	6.2
Chiller replacement	Medical School F Floor AHU Plant A, B, C and D	High Efficiency Turbomiser	190,000	45,598	145.0	1,388,000	4.2
Boiler Replacement	Trent Roof top	Condensing Heating Boiler replacement	14,930	667	4.0	22,256	22.4
	Nightingale Hall	Condensing Heating Boiler replacement	60,000	2,880	17	96,000	20.8
	Ancaster Hall	Condensing heating Boilers	45,000	2,370	14	79,000	19.0
Pump inverter drives	Sutton Bonington Boiler House	Inverters to Main site heating Pumps	8,550	4,250	21	43,800	2.0
	KMC	Inverters to Main CT pumps	5,876	3,624	17.6	36,424	1.6
	Plant Sciences	Inverters to AHU circuit pumps	4,414	2,333	11.3	23,328	1.9
Misc	Trent Building VT pump replacement	Replacement of main heating pumps	10000	826	4.0	8264	12.1
	Hallward Library CT pump replacement	Replacement of main heating pumps	9,000	1,446	7.0	14,462	6.2
	Medical School D and E Voids	Controlled Ventilation	220,000	47,600	186.0	1,139,000	4.6
	Medical School passing steam/ chilled water valves	New Control Valves	46,000	71,000	185.0	1,423,395	0.6
	Derby and Rutland Dining rooms	Inverter driven heat pumps	15,000	1,800	10.0	20,666	8.3
Fume Cupboards	Chemistry C13	Variable volume extract to 16 off Fume cupboards	90,000	19,788	134.0	744,000	4.5
	CBS phase 1 C22 floor	Auto sash closer to fume cupboards	25,000	9,975	56.0	266,000	2.5
Solar Technology	Vets School Clinical Sciences wing	1000m2 PV Array	223,000	26,000	69.0	127,115	8.6
			Total	Total	Total	Total	Average
TOTALS			2,136,070	339,793	1,390	7,825,918	14.3
Projects in advanced stages of development							
	Sutton Bonington site CHP	800kWe Gas fired CHP	1,549,000	310,000	1,612.0	n/a	5.0
	Sutton Bonington Wind Turbine	500kW Wind Turbine	1,782,000	422,000	885.0	1,633,000	4.2



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