CARBON MANAGEMENT PLAN

2016-19

University of Essex

1.0 EXECUTIVE SUMMARY

Energy security and the increasing concentration of greenhouse gases which contribute to climate change are one of the biggest challenges being faced today.

A detailed Carbon Management Plan (CMP) has been prepared which sets out the steps necessary for the University to achieve its target of reducing CO_2 emissions by 43 per cent by 2020 from a 2005 baseline.

The CMP has established the University's 2005 baseline at 33,679 tCO_2e encompassing emissions in scopes 1, 2, and 3. This CMP addresses emissions from all scopes which need to be reduced to 19,197 tCO_2e in order to meet the University's carbon reduction target. The CMP includes a breakdown of projects and activities required to achieve the reduction in scopes 1 and 2 (direct heat & power), which will need to be reduced from 16,105 t CO_2e to 9810 tCO_2e in order to meet the reductions target for direct emissions. Projects relating to the remaining indirect emissions (scope 3) will be addressed in a future update of the CMP due by end of academic year 2013/14 and projections have been based on likely reduction scenarios. It is probable that it will not be possible to achieve the full reduction required in scope 3 emissions and therefore will be necessary to realise a greater reduction from scopes 1 and 2 which are in the direct control of the University.

This CMP is predicated on reducing carbon emissions through a reduction in energy consumption in the first instance through improvements to building fabric, engineering installations, behavioural change in users, and developing buildings with a high thermal mass that have low energy demands. In conjunction with this onsite low-carbon energy generation options will be implemented as appropriate but recognising that the primary task should be reducing energy consumption. Energy costs are projected to rise significantly during the life of this CMP and therefore energy reductions may limit operational cost increases as opposed to delivering reductions in revenue expenditure.

It is projected that if implemented in full the measures in this CMP will reduce emissions, from heat and power on the University campuses to 5,514 tCO_2e by 2020 and overall emissions to 19,061 tCO_2e. Measures that have been proposed to reduce emissions include energy efficiency infrastructure, building user engagement and onsite renewable energy generation. The CMP also details measures that will have a carbon reduction impact, but will be delivered through the University's on-going Long Term Maintenance Programme (LTM), and the next phase of Capital Investment Plan (CIP) 2013-18 which will be developed alongside the new Estates Strategy, delivery of both the CIP and LTM are subject to funding streams outside the scope of this report and targets will need to be monitored and adjusted according to the scale and pace of those programmes.

The overall new investment required by the University to implement the measures outlined below is £19,934,376 which will need to be implemented through a phased programme. At this stage a budget figure of £3,706,824 (including VAT & professional fees) is required for the first two years of the programme. This covers IT upgrades, ventilation rationalisation, solar PV installation, and behavioural change measures. It is anticipated the combined effect of these measures in terms of carbon emissions will be a reduction in CO_2e emissions of 3,032 tonnes.

2.0 BACKGROUND

Energy security and the increasing concentration of greenhouse gases which contribute to climate change are one of the biggest challenges facing society today. This is an issue of fundamental importance to the University's strategic vision, and specifically the University's target of reducing carbon emissions by 43 per cent by 2020.

'Our strategy and vision is to be a university with global impact and an international reputation that is unparalleled for a university of our size.'[1]

In parallel with the environmental impacts of climate change are considerable financial pressures. The scarcity of fossil fuels and their location in some of the world's most turbulent regions means that fuel price inflation and energy security are major operational considerations for all those dependent upon them. Carbon emissions reductions broadly equate to reductions in energy consumption. It should be noted however, that given utility price inflation the effect of this programme may be to limit cost increases rather than to reduce them in absolute terms.

Alongside the operational and financial imperatives associated with carbon reduction there are important regulatory factors which will shape the University's low carbon future. The UK Climate Change Act (2008) sets legally binding targets to reduce greenhouse gas emissions by at least 80% by 2050 and at least 34% by 2020 from 1990 levels. In order to meet its international obligations on climate change the Government (through HEFCE) has sought to ensure that universities play their part in this and set a target to deliver a 43% reduction in carbon emissions on 2005 levels across the sector by 2020.

In the most recent round of Capital Investment Framework (CIF2) funding the University received £4m, (Teaching Grant total: £673,000, Research Grant total: £3.337m) which was contingent upon universities developing carbon management plans (CMP). The University of Essex met this requirement originally preparing a CMP in 2010; this document is a revision of the previous CMP and has been prepared in order to reflect changes in the University strategy and Capital Investment Plan (CIP) and aims to deliver the University's carbon reduction target by 2020. Future nationally agreed funding agreements are likely to impose environmental obligations on Universities and ensuring strong environmental performance now will make future compliance more straight forward.

The University is also required to comply with regulations that impose fiscal incentives for reducing its carbon emissions including the Carbon Reduction Commitment Energy Efficiency Scheme (CRC) and the Landfill Tax Escalator which place charges on carbon emissions and land filled waste respectively.

The Estate Management Section aims to ensure that the University is at the forefront of the Higher Education sector's efforts to mitigate its carbon footprint and is recognised as a leader in the sector for its work. The University's environmental footprint spans all University operations from teaching and research to managing its supply chain and providing services to students and staff. By effectively managing environmental performance the University can improve its effectiveness and efficiency as a whole. This will require good governance and leadership as well as integrating carbon reduction and sustainability with corporate strategies, polices, and operational procedures.

The Essex Sustainability Institute is driving the environmental curriculum at the University, it is essential for this programme's reputation and its recruitment & research goals to be based in an institution that is recognised as a high environmental performer. Rigorous monitoring of the University's administration, for example how it purchases goods and services will be an essential aspect of the drive to reduce Scope 3 emissions.

The CMP seeks to embed good practice within the University by encouraging and supporting all areas of the institution to take ownership and responsibility for projects to reduce carbon emissions. It will also contribute to improved results in the People and Plant Green League[2] survey, student surveys, and contribute to the Higher Education Sustainability Initiative for Rio+20[3]. The University will need to address its carbon emissions in order to ensure that its reputation for considering issues of global importance is maintained.

1 http://www.essex.ac.uk/about/strategy_and_vision/
2 http://peopleandplanet.org/greenleague
3 http://www.uncsd2012.org/rio20/hei_engage.html

3.0 INTRODUCTION

The CMP was first developed in 2010 for scope 1 and 2 emissions (direct heat and power) in fulfilment of HEFCE requirements and in order to meet the CIF2 bidding conditions. The CMP was first revised in 2011 when the carbon reduction target was extended from a 35 per cent reduction in emissions by 2020 on a 2005 baseline to a 43 per cent reduction. The scope was also extended from a focus on emissions scopes 1&2 (emissions from direct heat & power) to include scope 3 emissions (all other emissions). Table 1 below describes the various emissions scopes included in the University's carbon emission baseline.

Emissions Scope	Description	Status
Scope 1	Heating	Included
Scope 1	University fleet fuel	Negligible usage, excluded
Scope 2	Electricity	Included
Scope 3	Waste disposal	Included
Scope 3	Water use	Included
Scope 3	Supply chain	Included
Scope 3	Business travel	Included
Scope 3	Commuting to site	Included
Scope 3	Relocation from home to University	CO2 tonnage not currently measured, to be included 2014
Scope 3	Refrigerants	Negligible usage, excluded

Table 1

Following submission of a review of the progress on the original CMP to University Steering Group on 10 June 2013, it was agreed that the CMP be revised to include a more detailed implementation plan and to set out the resources and investment required to ensure the University meets its already agreed carbon reduction target.

A detailed analysis of the University's emissions can be found in section 4.1 (Baseline, target and scope), this highlights that the University's total emissions currently stand at 39,228 tonnes CO_2 equivalent (tCO_2e). The University's emissions comprise of direct (scopes 1&2) and indirect emissions (scope 3). In order for the University to achieve its overall carbon reduction target across all scopes, emissions must be reduced to 19,197 tCO_2e by 2020[4].

This CMP deals mostly with scope 1 and 2 emissions (as originally required by HEFCE) which currently stand at 16,105 tCO_2e and need to be reduced to 9,810 tCO_2e by 2020 to meet that proportion of the carbon reduction target. Plans for reducing scope 3 emissions are referred to and will be developed further. It is recognised that it will be necessary to seek further reductions from direct emissions sources (scope 1&2) in order to meet the overall target due to the relative difficulty in controlling scope 3 emissions.

There are a number of risks inherent in the CMP, detailed in the risk register, section 7.1. Fundamental strategic risks include; firstly, a risk that the range of outcomes that can be achieved through the implementation of proposed measures does not match the projections and therefore more savings are required than initially projected. Secondly the University Strategic Plan seeks to expand the student population of the University by 50% during the life of the CMP. Given that the CMP is required to achieve carbon reductions in absolute terms this effectively means that a higher level of savings is required to counteract the increase in numbers. Table 2 below shows the impact of growth on carbon emissions, with three new buildings predicted to add nearly 1000 tCO_2 to the University's carbon footprint, adding £11,448 to University costs from Carbon Reduction Commitment obligations alone.

Building	Completion date	CO2e impact (tonnes per annum)
Essex Business School August 2014		0
New student accommodation	October 2013	750
Student centre & library extension	December 2014	204

Table 2

Progress with implementing the CMP will be monitored through the Estates and Professional Services KPIs (KPI6) and reported through USG.

4 Baseline and yearly carbon figures are subject to adjustment following changes to Defra carbon calculation metrics and new data gathered by the University. The next revision is expected in 2014 when CO2e figures for commuting and relocation from home to university have been included.

4.0 BASELINE, TARGET AND SCOPE

This CMP sets out how the University will address carbon emissions from all scopes, setting out an implementation plan to reduce emissions by 43 per cent from emissions scopes 1&2 and setting a baseline and quantifying scope 3 emissions in preparation for a detailed scope 3 emissions reduction plan in future CMP updates, due July 2014.

Baseline data in compiling the CMP has been collected from a number of sources, the accuracy of information varies depending on its source. For example, the accuracy of gas & electricity meters is defined by statute, whilst carbon figures for staff commutes are based on surveys and extrapolations[5]. Table 3 below sets out the data sources used;

Emission	Data source (and unit)	Data quality
Heat	Meter (kWh)	Data collected since 2005, quality excellent
Electricity	Meter (kWh)	Data collected since 2005, quality excellent
Waste	Report from disposal contractor (tonnes)	Data collected since 2011, quality good
Water	Meter (litres)	Data collected since 2011, quality excellent
Supply chain	University financial data (£)	Data collected since 2011, quality fair
Business travel	travel expenses claims (Miles travelled / £ claimed)	Data collected since 2011, quality fair
Commuting to site	Survey (Miles travelled)	Collected since 2013, based on extrapolations from travel surveys
Relocation from home to university	Survey (Miles travelled)	Not currently collected

Table 3

The baseline has been established by using Defra carbon conversion factors, metrics which convert units of measurement into their carbon dioxide equivalents. There are several greenhouse gases, since carbon dioxide is the most prevalent, other greenhouse gases are converted into an equivalent in carbon dioxide (CO_2e) based on their greenhouse gas intensity. For example 1 tonne of methane is equivalent to 20 tonnes carbon dioxide.

5 A survey of meters by the National Measurement Office found that 93 per cent of meters were accurate to within Government statutory limits of +2.5% to -3.5%.
http://www.bis.gov.uk/nmo/gas-and-electricity-meters/electricity-meters-introduction/Electricity-meter-accuracy-and-billing-disputes

To provide some context, approximately 1850kWh of electricity use in the UK creates one tonne of CO_2 which is equivalent to:

- 10 x 60 watt tungsten filament light bulbs that are on for 3,000 hours, or 125 days,
- a medium sized coffee machine in a café running for a year; or
- a standard sized domestic electric oven running for an hour a day each year[6]

In order to meet the carbon reduction target of 43 per cent as identified above, the University will need to restrict its overall carbon emissions to 19,197 tonnes CO_2e per annum by 2020 as outlined in table 4 below.

	2005/6 Baseline	2011/12	2020 Emissions target	2020 Business as Usual emissions
Total emissions (tCO2e)	33,679	39,228	19,197	43,605
Scope 1&2 emissions tCO2e	17,210	16,105	9,810	19,937
Scope 3 emissions tCO2e (includes supply chain, travel, waste & water)	16,469	23,123	9,616	27,738

Table 4

As illustrated above, overall emissions have risen from 33,679 t CO_2e in 2005/6 to 39,228 tCO2e in 2011/12. With Scope 1 & 2 emissions having fallen since the baseline year, this is largely attributable to the rise in scope 3 emissions, which have risen by 16 per cent since 2005/6. Without mitigation measures carbon emissions will peak in 2017/18, and level off in subsequent years assuming student numbers peak at 10,485 students in line with current Strategic Planning & Change Section forecasts, although these will be amended upwards once the method delivering growth in student numbers as required by the University Strategic Plan has been determined. In 2005, the University comprised just 7,989 FTE students, with an annual turnover of £101 million. This has since risen to 10,656 FTE students on a turnover of £154 million in 2011/12. As student numbers and turnover have risen, there is more demand for utilities and more goods & services are purchased; increasing demand for resources and therefore carbon emissions. Student numbers and carbon emissions are positively correlated with a coefficient of 0.84.

The Carbon Management Plan has taken account of future University growth by analysing the relationship between student numbers and carbon emissions and then using student number forecasts provided by the Strategic Planning & Change Section to estimate a 'Business as Usual' (BAU) scenario which models unrestricted carbon growth. All models for reductions therefore have to demonstrate a reduction in University emissions from current levels and also allow for expansion of staff and student numbers in accordance with the University Strategic Plan. The graph shows the relative change and future forecasts in carbon emissions, student numbers and turnover up to 2020. Three carbon scenarios have been plotted; unrestricted carbon growth, carbon emissions under currently planned measures and a CMP emissions scenario.

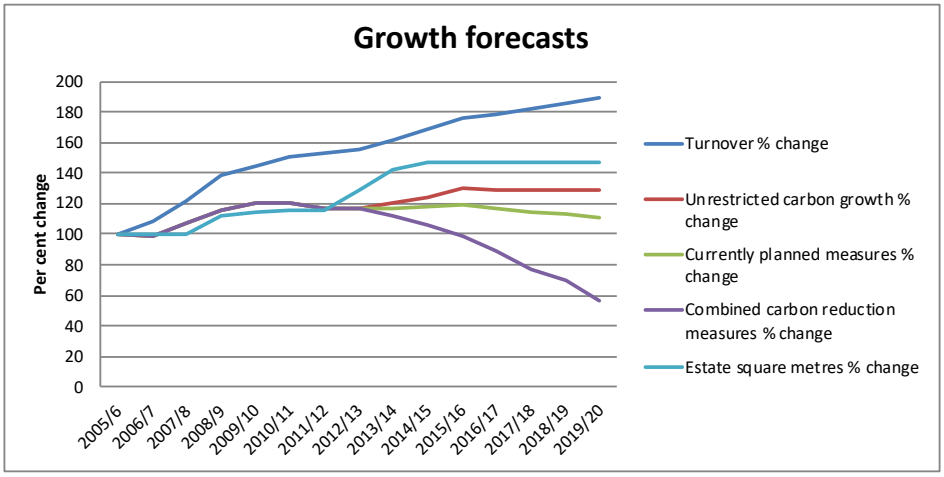

Figure 1

6 Carbon Management & Implementation Plan, 2011, Queen Mary, University of London, 2011

Although the carbon reduction targets relate to absolute carbon emissions the per capita carbon emissions indicate relative levels of efficiency in the use of the Estate. In this case the per capita carbon emissions have fallen since 2005/06 due to the increases in student numbers which have largely been accommodated within the existing Estate (see Table 4). It should be noted that in order to deliver the University Strategic Plan aims relating to expansion and excellence in research and excellence in education without increasing carbon emissions greater levels of efficiency will need t be achieved.

	2005/6	2011/12	2020 Carbon Management Scenario	2020 BAU Scenario
Carbon (tCO2e) emissions per FTE student	4.22	3.7	1.9	4.5

Table 5

The CMP takes into account predicted changes to baseline carbon emissions to 2020 resulting from:

- Increases in student numbers (based on current forecast average growth of 166 additional students per annum);
- Increases in the size of the estate (forecast to grow to approximately 254,644m^2 by 2020 – an increase of 47 per cent on the 2005 estate);

A rise in baseline carbon emissions of 29% by 2020 is forecast as a result of increases in student numbers and the size of the Estate as illustrated in Figure 1.

Overall, the main factors which will influence changes in baseline carbon emissions between now and 2020 are growth in student numbers, expansion of the built estate and changes in carbon conversion factors (which are used to calculate the carbon emissions from the actual consumption).

The Department of Energy and Climate Change began consulting on its Electricity Market Reform Delivery Plan, July 2013[7]. Successful implementation of the plan will result in significant decarbonisation of the grid, in line with Government obligations under the Climate Change Act. However, it would be unwise to rely on grid decarbonisation to achieve the University's carbon reduction target for two reasons. Firstly, the Government may be unsuccessful with its plans to decarbonise the grid. Secondly, if the Government is successful it may be as a result of increasing energy costs to pay for low carbon infrastructure at a national level, if the University does not increase energy efficiency and off-grid energy generation it risks significant exposure to price increases over and above previous rises in the region of 15 per cent.

The significance of the carbon reduction task can be considered in terms of the numbers of University buildings that would have to be closed permanently in order to meet the 43% reduction target without implementing any further carbon reduction measures, for example the target could be met if we closed the following:

1. South Courts residences
2. The Human Rights Centre & Law Building (Formerly Physics)
3. Bio Science
4. Southend Gateway Building
5. Houses 1 to 6, Colchester Campus
6. University Square, London Road, Southend

Apart from scope 3 emissions (mainly a function of the University's supply chain), the biggest sources of emissions are heat and power use in buildings. The University has 3 campuses in Colchester, Southend and Loughton comprising a wide variety of buildings. As can be seen below in figure 2, the larger Colchester Campus is responsible for the vast majority of University emissions.

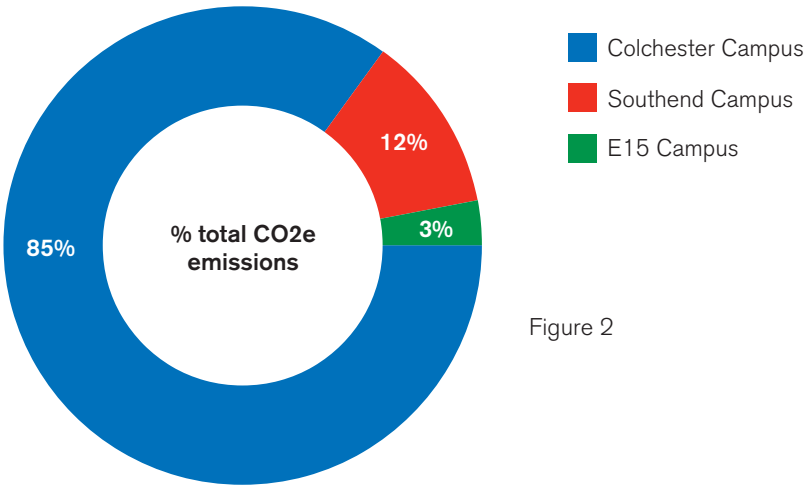

Figure 2

7 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/238867/Consultation_on_the_draft_Delivery_Plan__amended_.pdf

5.0 CMP IMPLEMENTATION PLAN

Introduction

This section sets out how the Carbon Management Plan will be implemented. It is further sub-divided according to the types of measures that are proposed to enable the University to meet its target, these are:

1. Building energy efficiency measures (scopes 1&2)
2. Energy generation measures (scopes 1&2)
3. Building user engagement measures (scopes 1&2)
4. Transport infrastructure & engagement measures (scope 3)
5. Other engagement measures (all scopes)

The table below sets out the expected costs and carbon reduction yields for each type of measure.

Description		Notes	Cost (£)	CO2e reductions (t)	Planned Delivery Date	Lead
5	Carbon Reduction Measures					
5.1	Building energy efficiency measures	Includes all installations of equipment & building fabric upgrades. Costs and carbon reductions cummulative over period of CMP	3,861,800	1,589	2013-20	Energy Manager
5.2	Energy generation measures	Includes all installations of renewable and low carbon energy generation technology. Costs and carbon reductions cummulative over period of CMP	10,910,000	2,256	2013-20	Energy Manager
5.3	Building user engagement measures	Includes all measures aimed at encouraging building users to mitigate carbon intensive behaviours. Costs and carbon reductions cummulative over period of CMP	130,000	2,300	2013-20	Carbon Change Advisor
5.4	Transport infrastructure & engagement measures	Includes measures aimed at encouraging modal shift and infrastructure measures faciliting sustainable modes of transport. Costs and carbon reductions cummulative over period of CMP	200,000	1,022	2013-20	Transport Policy Coordinator
5.5	Scope 3 measures	Includes all measures aimed at reducing carbon emissions from all other sources	TBD	9,100	2013-20	Carbon Change Advisor
5.6	LTM & CIP measures	Measures yielding carbon savings, implemented as part of ongoing building upgrades	Subject of separate funding bid	1,909	2013-2020	Director of Estates
		Grand total	**15,101,800**	**18,176**		
		Total + management fees	**16,611,980**			
		Total + VAT	**19,934,376**			

Table 6

The impact of implementing the carbon reduction measures can be seen in figure 3 below.

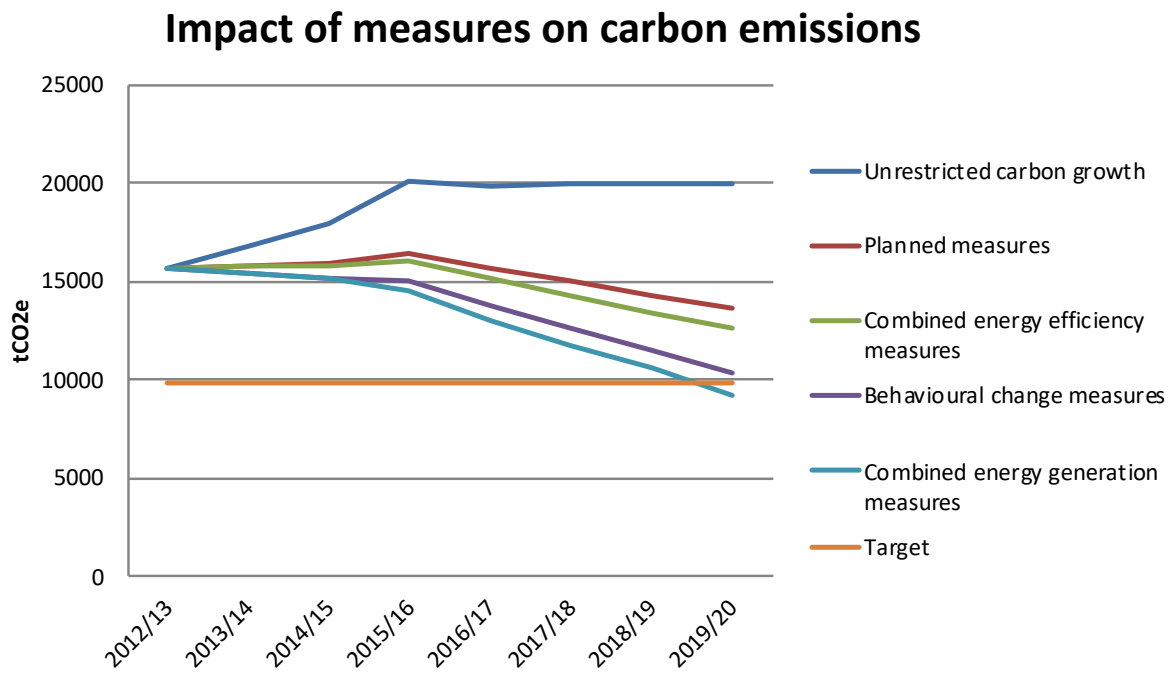

Figure 3

This CMP is an update on the original CMP produced in 2010 and then revised in 2011. Previous carbon reduction work has been funded through the HEFCE/Salix programme, a government sponsored scheme that provides loans for carbon reduction measures with short payback periods (savings accrued from the project payback the investment in 6 years or less). To date these measures have cut carbon emissions on campus by 757 tCO2e. It has been estimated that projects already planned that are to be funded through Salix, the Revolving Green Fund or an existing Estates Management allocation will reduce emissions by 6,368 tCO2e, as per the Salix and Estate Management (Maintenance) project plans. These projects include currently planned Building Management System (BMS) installation (Estates funded) and draught exclusion and insulation in easy to treat areas, enabling projects to be funded under the Salix '6 year pay back rule'. In order to achieve the University's target, measures unsuitable for external financing need to be undertaken and have been outlined in the Implementation Plan below.

Carbon emissions will also be reduced as a result of upgrades to the building fabric and building engineering systems which will be delivered through the University's new Capital Investment Programme (2013-2018) and as part of the future LTM programme. Projected savings from these programmes between now and 2020 amount to 1909 tCO2e and have been included in this carbon analysis. While the funding for these programmes falls outside of the CMP, if they are not delivered to the extent modelled in the CMP it will affect the University's ability to reach the carbon reduction target by 2020.

Overall emissions

The University's 2005 overall baseline is calculated to be 33,679 tCO2e. The measures, so far calculated, yield savings of 18,176tCO2e. Measures relating to transport emissions and other scope 3 emissions have been calculated, using Carbon Trust guidance, based on an estimate of likely savings given the University's financial turnover. It is proposed that a detailed implementation plan be produced by the end of academic year 2013/14 for measures specifically to address scope 3 emissions. The majority of the savings from scope 3 emissions will be yielded from improved supply chain management and are not envisaged to pose a significant resource burden on the University.

Emissions scopes 1&2

The 2005 baseline for emissions scopes 1&2 only is 17,210tCO2e. Emissions for the year 2011/12 stand at 16,105tCO2e. Under an unrestricted carbon growth scenario, emissions are likely to rise to 19,936 tCO2e by 2020. The introduction of the measures in this report will reduce the University's overall scope 1&2 emissions by 6,145 tCO2e, with additional LTM & CIP measures yielding a further 1,909 tCO2e reduction.

Prior to this revision of the CMP, consultants Arups were engaged to assist with the University's analysis of its carbon footprint. A range of costed carbon reduction measures have been prepared and analysedby Estates Management Section. The carbon reduction yields & costs are estimates based on Arups' previous experience. Arups have made per m^2 calculations based on the building type and age across the University's three campuses. Only those measures which were deemed suitable for the University Estate have been included in this report, it should be noted that the high level nature of such estimations necessitates that the University should aim to .

Figure 4 below illustrates where carbon emissions from heat and power are accruing. Although the Colchester Campus accounts for significant heat and power emissions, a building by building survey of University emissions shows that there are buildings located on other Campuses with significant carbon footprints. It is notable that nearly 50 per cent of the University's scope 1&2 carbon emissions come from the top 4 highest emitting buildings across the 3 campuses.

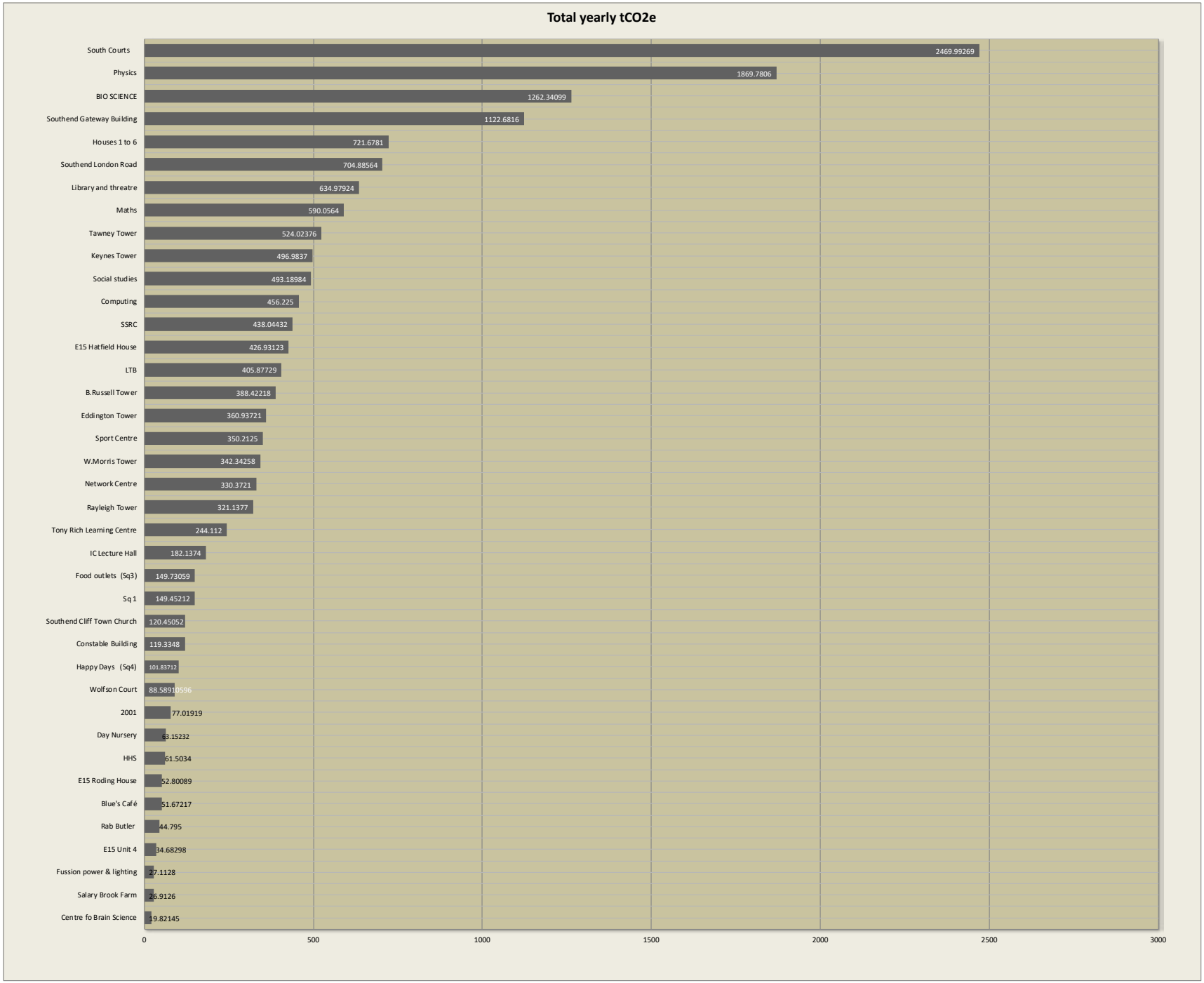
Total yearly tCO2e
South Courts
Physics
BIO SCIENCE
Southend Gateway Building
Houses 1 to 6
Southend London Road
Library and threatre
Maths
Tawney Tower
Keynes Tower
Social studies
Computing
SSRC
E15 Hatfield House
LTB
B.Russell Tower
Eddington Tower
Sport Centre
W.Morris Tower
Network Centre
Rayleigh Tower
Tony Rich Learning Centre
IC Lecture Hall
Food outlets (Sq3)
Sq 1
Southend Cliff Town Church
Constable Building
Happy Days (Sq4)
Wolfson Court
2001
Day Nursery
HHS
E15 Roding House
Blue's Café
Rab Butler
E15 Unit 4
Fussion power & lighting
Salary Brook Farm
Centre fo Brain Science
2469.99269
1869.7806
1262.34099
1122.6816
721.6781
704.88564
634.97924
590.0564
524.02376
496.9837
493.18984
456.225
438.04432
426.93123
405.87729
388.42218
360.93721
350.2125
342.34258
330.3721
321.1377
244.112
182.1374
149.73059
149.45212
120.45052
119.3348
101.83712
88.58910596
77.01919
63.15232
61.5034
52.80089
51.67217
44.795
34.68298
27.1128
26.9126
19.82145
0
500
1000
1500
2000
2500
3000

Figure 4

5.1 Building energy efficiency measures

The cost of the measures outlined below includes other associated works, which whilst not reducing carbon, are necessary to ensure the measures are effective.

The Estate consists of 141 buildings across 3 campuses. The buildings have been analysed in terms of their carbon performance and potential for further carbon reduction. The table below shows the measures to be implemented in each building. The types and location of measure have been categorised following a high level survey of the Estate by external consultants Arup, the detailed condition survey being undertaken by consultants and due to report in late 2013 will provide greater levels of granularity and may highlight more opportunities.[8]

Description		Notes	Cost (£)		CO2e reductions (t)	Planned Delivery Date	Lead
5	Building energy efficiency measures		Project cost	Payback in years			
5.1.1	Power management software & server room upgrade	Power management of PC lab machines & university supplied staff IT equipment. Rationalisation of server room equipment	63,000	1	126	2014*	Energy Manager
5.1.2	Power management Software - efficient control of workstation equipment	Power management of PC lab machines & university supplied staff IT equipment. Introduction of soft client. This also reduces air conditioning loads	5,720	1	70	2014*	Energy Manager
5.1.2	Rationalisation of existing ventilation systems	The calls on the building envelope have changed significantly since the original campus was first constructed in the 1960s. This rationalisation will enable our buildings to respond more efficiently to the current demands of students and staff	331,500	17	182	2015	Energy Manager
5.1.3	BMS and controls upgrade	The current building management system dates from the late 1980s. A programme of modernisation will allow increased information and control yielding improved energy performance	1,764,700	16	474	2016-2019	Energy Manager
5.1.4	Voltage optimization	Installation of controls to regulate power supplied to the University	1,702,600	19	595	2015-16	Energy Manager
5.1.5	Roof insulation to buildings	Approximately 1/3 of building heat loss is through roofs. This measure will ensure roofs not already treated are enhanced for improved comfort and energy saving	Externally funded via RGF	0	213	2015-2018	Energy Manager
		Grand total	**3,861,800**		**1589**		
		Total + management fees	**4,247,980**				
		Total + VAT	**5,097,576**				

Table 7

*Roll out date dependant on departments other than Estates Management Section

The energy efficiency measures outlined above will reduce carbon emissions by 1,589 tCO2e by 2020 and represent 9 per cent of the total carbon reduction target.

8 University of Essex Carbon Reduction, Proposed Interventions on Each Campus, August 2013, Arup.

5.2 Energy generation measures

Whilst the University recognises that energy reduction through a programme of behavioural change and installation of energy efficiency measures can deliver significant carbon reduction, the University benefits from a large estate over three campuses which offers suitable locations for renewable and low carbon energy generation technology.

Description		Notes	Cost (£)		CO2e reductions (t)	Planned Delivery Date	Lead
5	Energy generation measures		Project cost	Payback in years			
5.2.1	Photovoltaics	Solar panels displacing grid electricity, located on rooftops, Colchester Campus	2,283,700	20	424	2015	Energy Manager
5.2.4	Wind Turbine (1300kW)	Surveys indicate sufficient windspeeds on Colchester Campus for displacment of grid electricity with renewable wind energy	1,373,500	17	293	2019	Energy Manager
5.2.5	135kW Gas CHP & absorbtion chiller	A tri-generation system providing power, heating and cooling, located in the Gateway Building Southend	300,000	10	359	2016	Energy Manager
5.2.6	2MW Gas CHP	A CHP unit providing heat & power to central buildings & South Courts, Colchester Campus	6,952,800	29	1180	2017	Energy Manager
		Grand total	**10,910,000**		**2256**		
		Total + management fees	**12,001,000**				
		Total + VAT	**14,401,200**				

Table 8

The total measures outlined above will reduce carbon emissions by 2,256 t CO2e. In the case of the proposed photovoltaics (PV) and wind turbines, it will be possible to further reduce emissions by increasing the number of installations, should finance & planning issues allow. Further investigations will be required as part of feasibility and business case development, it is possible that combining PV with external roof insulation may allow for the use of the PV arrays as a rain screen cladding and that a large wind turbine can be used to signify the entrance to the knowledge Gateway.

5.3 Building user engagement measures

Encouraging building users to consider how their behaviour effects carbon emissions is one of the most cost effective approaches to delivering improved carbon performance. By developing an environmental consciousness in staff and students, the University is also developing thoughtful global citizens and fulfilling its aim to be an institution with a global impact.

Description		Notes	Cost (£)		CO2e reductions (t)	Planned Delivery Date	Lead
5	Building user engagement measures		Total cost	Payback in years			
5.3.1	Student switch off	Incentives for students living in halls of residences to reduce their energy impact & resource. Includes cost of employing students as auditors. Run in conjunction with NUS	44,000	<1 year	1,150	2014-20	Carbon Change Advisor
5.3.2	Green Impact	Incentives for staff to reduce their energy and overall environmental impact. Energy champions assigned in each participating department to oversee departmental environmental performance. Includes cost of employing student environmental auditors	44,000	<1 year	1,150	2014-20	Carbon Change Advisor
5.3.3	Staff training	Ensuring that staff with roles that have significant environmental impact are aware of how their roles can impact the environment and are given assistance mitigating their impact	25,000	Not quantified	Not quantified	2014-20	Carbon Change Advisor
5.3.4	Green staff inductions	All new staff made aware of the University's carbon targets and their role in helping achieve them	8,500	Not quantified	Not quantified	2014-20	Carbon Change Advisor
5.3.5	Green student arrivals	All new students made aware of the University's carbon targets and their role in helping achieve them	8,500	0	Not quantified	2014-20	Carbon Change Advisor
5.3.6	Consequential refurbishment	All refurbishments to be assessed for carbon impact. Where refurbishment is likely to increase University's overall footprint, additional funding at £150/tCO2e is requested in bids to the Space Management Group to cover this increase. This charge will ensure funds are set aside to cope with additional costs from increased utility and Carbon Reduction Commitment costs. This policy is effectively cost neutral for the University. Whilst not yielding carbon savings, the policy ensures University growth does not come at expense of overall carbon footprint.	TBD	TBD	0	2014-20	Deputy Director Estates, Capital & Development
5.3.7	Zero carbon new build	The new building to house Essex Business School has shown that all new buildings can be net zero carbon. To ensure University growth does not come at the expense of its carbon footprint, this policy will stipulate all new buildings are net zero carbon.	Currently IRO 10% above building regs. (Reduces to zero by 2018 with stricter Part L)	TBD	0	2014-20	Deputy Director Estates, Capital & Development
5.3.8	Fiscal incentives	Based on data from Green Impact programme, departments in bottom half of the table are charged, on a sliding scale, an average of £12 per tonne of carbon, refunded, on a sliding scale to departments in the top half of the table. This allows the University to reward departments that have a low environmental impact. The programme is designed to stimulate grass roots behavioural change initiatives. The cost of carbon is set in year 1 in line with CRC costs per tonne but can be increased or reduced depending on the amount of innovative carbon reduction stimulated.	TBD	TBD	TBD	2014-20	Carbon Change Advisor
		Grand total	**130,000**		**2,300**		
		Total + management fees	**143,000**				
		Total + VAT	**171,600**				

Table 9

The quantified building user engagement measures are projected to reduce overall CO_2e emissions by 2300 tonnes or 13 per cent of the total carbon reduction target. This is based on analysis of the University's footprint by NUS and their previous experience delivering behavioural change campaigns such as Green Impact and Student Switch Off at peer universities.[9]

9 A linear reduction model has been used for behavioural change measures, assuming equal reductions year on year. In practice reductions will vary, with most significant reductions likely in the early years of the programme before levelling off once good environmental behaviour becomes the norm.

5.4. Transport infrastructure and engagement measures

The University seeks to reduce its emissions from transport by encouraging modal shift, i.e. the move away from carbon intensive travel on planes and in private vehicles to public transport, walking and cycling. Alongside this the University recognises the need to develop infrastructure to make low carbon travel convenient and safe. Since the nature of travel means emissions occur off campus, the University recognises the importance of partnership working for delivery of its transport carbon reduction measures. The University will set out an implementation plan to reduce emissions from these sources in a future update of the Carbon Management Plant by the end of academic year 2013/14.

Total transport emissions have risen from 2335 tCO_2ein 2005/6 to 2722 tCO_2ein 2012/13. The single biggest source of emissions being business travel emissions which stood at 2332 tCO_2e in 2012/13. The associated costs of transport emissions are currently £1,276,689.[10]

5.5 Other engagement measures

The University recognises the significant contribution to greenhouse gas emissions from sources other than building use and transport. The University will set out an implementation plan to reduce emissions from these sources to be appended to the CMP by 31 July 2014.

If the measures proposed in 5.1-5.3 are adopted, and the University implements its LTM and CIP programmes as envisaged below, the University will need to reduce scope 3 emissions (excluding transport emissions, already discussed above) by 9,100 tCO_2e. This can be achieved by capping future emissions growth from the University's supply chain. This is of course not an easy task and will require full engagement by all staff involved in the specification and procurement of goods and services enabling these staff to understand the carbon implications of purchasing decisions. In tender evaluations carbon emissions and energy consumption should be a ey consideration as should an analysis of the "whole life" cost. Attaching a value through the lifespan of a good will potentially alter purchasing decisions and may not mean that the cheapest capital cost represents the best value through the life of an item e.g. the purchase of PCs and laptops where the energy use through the life of the product far exceeds the initial investment. Through this process it will also be necessary to engage with University suppliers as part of the procurement process, using the University's purchasing leverage to require suppliers to reduce emissions associated with their goods and services below national benchmarks.

Emissions from sections of the University supply chain have been given high estimates as sufficient purchasing data was unavailable – over 20 per cent of the University's external purchasing is not attributed to specific procurement categories. This is a key area where the Central Purchasing Unit working alongside colleagues with expertise in whole life costing will be able to add real value to the procurement process of a wide range of goods and services. If the University improves its management of this purchasing additional 'on paper' savings can be made.

5.6 Long Term Maintenance (LTM) & Capital investment Plan (CIP)

A number of additional measures were considered as part of the review of the CMP. The measures outlined below are those measures considered but will which be implemented as part of the LTM or CIP programmes and therefore funding sought from those programmes. The envisaged carbon savings are 50 per cent of the predicted carbon savings from each measure to allow for the long term nature of these programmes and because the roll out of the LTM and CIP programmes will cover a period longer than the target date for the CMP. The University can therefore expect to accrue on-going carbon reductions from LTM & CIP beyond 2020 from additional equipment installed through these programmes. The expected life of energy efficiency & energy generation equipment can be as long as 50 years (in the case of roof insulation installation & building envelope upgrades), with equipment mitigating carbon emissions over its lifetime. Replacement of equipment is normally cheaper than the cost of its original installation as it is less reliant on additional service works. In section 5.2 for example the budget cost for delivering the gas fired CHP project includes significant infrastructure costs for the supply and distribution of heat to residences and also for the construction of a building to house the plant. The most cost effective solution would therefore be to incorporate into the CIP or LTM refurbishment elements and to combine with boiler replacement and building refurbishment and re-organisation works.

Description		Notes	Cost (£)		CO2e reductions (t)	Lead
5.6	LTM & CIP		Total	Payback in years		
5.6.1	Lighting controls	Installation of motion sensing equipment	677,900	45	67	Energy Manager
5.6.2	Enhancements to sub-metering and AMR system	AMR improves information on energy use. This can enhance BMS systems and enable more effective behavioural change work. Following a feasibility study this will also be linked to internal fiscal incentives for carbon reduction	462,675	17	171	Energy Manager
5.6.3	High efficiency lighting	High efficiency lighting has already been installed in some priority areas but further roll out will yield increased carbon savings	701,175	17	254	Energy Manager
5.6.4	Upgrade existing building envelope	Major upgrade to main buildings on Colchester Campus, involving insulation cladding. Undertaken as part of refurbishment works	18,624,250	119	1418	Director of Estates
		Grand total	**20,466,000**		**1909**	

Table 10

6.0 FINANCE

10 Costs from transport emissions are accrued from expenses payments for travel tickets and vehicle mileage payments.

To implement all the measures in the CMP the University would need to allocate a capital investment of £19,934,376 including VAT and associated professional fees as detailed in tables 6, 7, 8 and 9. All the measures deliver a 'pay back' to the University in terms of reduced energy bills.

It is currently proposed that a sum of £3,706,824 be allocated to cover the first two years of the programme & the delivery of the following measures:

- IT upgrades
- Rationalisation of ventilation systems
- Solar PV Panels
- Behavioural change measures

It is anticipated the combined effect of these measures in terms of carbon emissions will be a reduction in CO_2e emissions of 3,032 tonnes.

Investment in measures to reduce our carbon footprint enables the University to achieve its target of reducing carbon emissions by 43 per cent by 2017, and also avoid exposure to on-going fuel price inflation, currently running at 15 per cent per annum. If the University was able to install all measures outlined above, instantaneously, reducing emissions from scopes 1&2 to 5514 tCO_2e, its combined bill for the period to 2020 would be £9,864,446 instead of £27,331,921 if no measures are implemented or £17,361,971 if measures are implemented according to the timescales proposed.

Figure 5 below, explores the cost implications of scope 1&2 emissions which have a direct bearing on the University in the form of utility bills and CRC payments. It forecasts different costs expectations under unrestricted carbon growth scenarios, in comparison to measures already planned and the combined sum of measures proposed in this CMP & carbon savings yielded from the LTM and CIP programmes. Two projections have been forecast for each scenario, a static utility price and a utility price including inflation at 15 per cent. 15 per cent is an indicative figure based on previous utility bills since 2005. The cost of compliance with the Carbon Reduction Commitment, currently £12 per tonne of carbon emitted has been included in all projections.

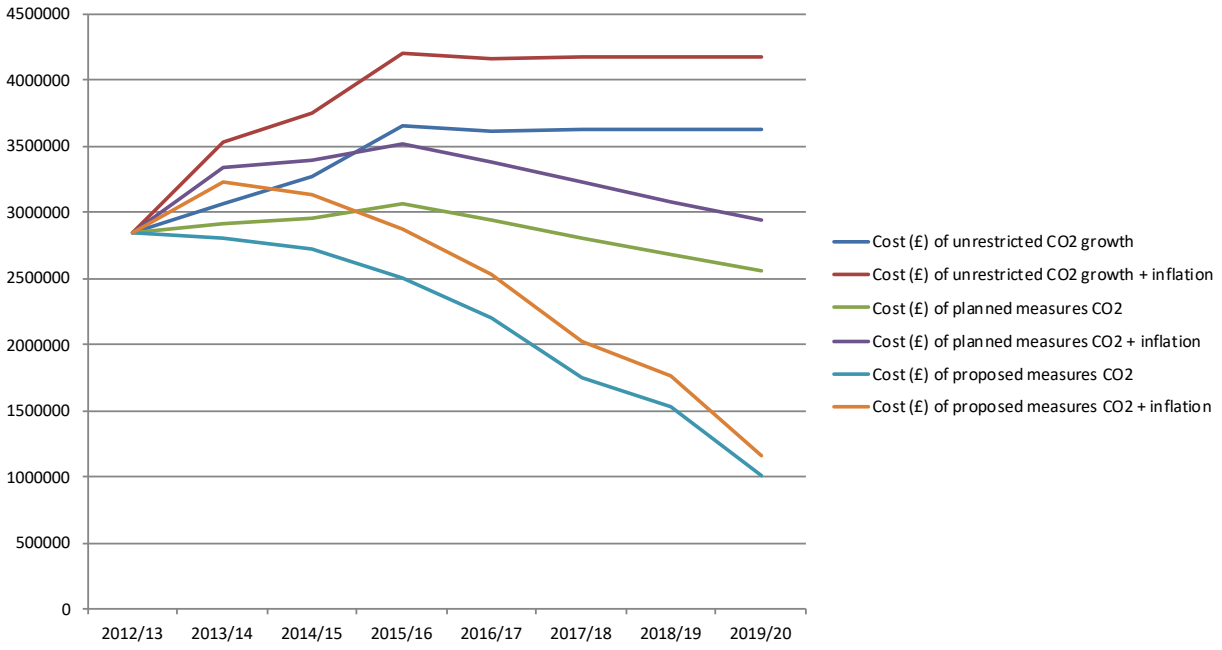

Figure 5

Under a scenario of unrestricted carbon growth, utility bills can be expected to rise from £2,839,857 per annum to £3,628,373 in 2020 at current prices. Once inflation has been factored in, the University's 2020 utility bill would be £4,172,629[11]. However the University already has plans to install some energy efficiency measures, paid for with Salix & RGF funding, so utility bills are more likely to be £2,554,797 or £2,938,016 accounting for inflation. The University could make significant reductions to its utility bills if the proposed CMP measures are adopted and additional savings from LTM & CIP programmes are realised, with projected bills in 2020 forecast at £1,003,513 or £1,154,040 including inflation.

11 K Government estimates for energy prices are published in link below. However, forecasts have been made using internal data on utility prices as Government predictions relate to wholesale prices, which can vary significantly from the price charged to organizations by utility companies. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/239937/uep_2013.pdf

Under the CMP plan scenario the combined energy bill for the period to 2020 is expected to be £19,540,288. The forecast energy bill with no action, other than existing measures is £25,739,180 and the difference between the two scenarios is £6,198,892.

Consideration has only been given to financial resources. It is envisaged that the CMP will be delivered, in the main, by existing Estates Management Section staff, with guidance, where appropriate, from external consultants, included in the costs of project estimations. It will be necessary to work with staff from all departments and sections, the extent of involvement from non-Estates staff will be determined during an I-lab session planned for December 2013 (See section 10.2).

7.0 RISKS AND OPPORTUNITIES

Although there is some degree of uncertainty over the final carbon benefit of any given measure, all the technologies needed to reduce the University's carbon footprint are currently available on the open market. The main factor influencing delivery is leadership and political will. However, the complex nature of implementing carbon abatement measures means that it is necessary to undertake a rigorous analysis of risk. Risk has already been built into the proposed projects through its NPV analysis which uses a discount rate of 5 per cent. The risk register below outlines the key risks, their likelihood, impact and measures to mitigate their impact should they arise.

Risk	Likelihood	Impact	Mitigation
Carbon Management is not seen as a strategic priority by the University.	Medium	High	Behavioural change campaign aims to keep carbon management high on University agenda. Vice Chancellor receives termly updates on carbon management progress.
Reputational risk resulting from the University not demonstrating its commitment to environmental sustainability/ carbon reduction.	Medium	High	The University has developed this Plan, and has also ensured that appropriate governance arrangements are in place to ensure its successful implementation.
Carbon reduction yields from projects not as great as envisaged by forecasts	Medium	High	Conservative estimates for the yields have been provided. It is likely that where there are cases of under delivery in certain areas, there will be over delivery in others. AMR systems will allow high performing projects to be rolled out more widely in a timely manner and also identify underperforming projects for remedial action.
Internal funding for the implementation of the projects is not available.	Low	High	Proposals put forward are cost effective and allow the University to reduce its dependence on high cost fossil fuels and payback over the long term
University is unable to achieve scope 3 savings	Medium	High	High estimations have been made for scope 3 emissions due to poor supply chain data. The University can immediately improve its 'on paper' position with regard to these emissions by improving its overall supplier management systems.
Staff & students do not participate in relevant carbon reduction Projects.	Low	High	This plan proposes significant investment in behaviour change & staff engagement to ensure a positive response to carbon reduction measures.
An increase in student numbers, over and above those currently envisaged by the Strategic Planning and Change Section, energy intensive research or reconfiguration of degrees, such as two year degrees or 24 hour opening increases on campus energy use.	Medium	High	This plan proposes that all new development & refurbishment is zero carbon. This will mean allocating additional funds to expansion projects to ensure that the University can grow without impacting its carbon target.
Planning permission not granted for energy generation projects.	Medium	Medium	The Estates Section has considered a range of additional measures outside this CMP, which can be implemented should any of the proposals prove to be unfeasible. The University will continue to consider other measures as costs associated with implementation reduce and technologies develop.

8.0 BEYOND 2020

This CMP covers the abatement measures needed to ensure the University is able to reduce its CO2 emissions by 43 per cent by 2020 from a 2005 baseline. It is not currently feasible to accurately envisage what sort of ongoing carbon abatement work will take place beyond 2020 as technologies, costs and benefits are likely to have changed significantly by then. However, it is possible to model future climate which will provide some insight into the type of environment the University will be operating in by 2020 and beyond.

Our climate is already changing around us and has changed significantly within our lifetime. Since the mid 20th Century:

- All regions of the UK have experienced an increase in average temperatures between 1961 and 2006 annually, and for all seasons. Increases in annual average temperature are typically between 1.0 and 1.7 °C, tending to be largest in the south and east of England and smallest in Scotland.
- Sea-surface temperatures around the UK coast have risen over the past three decades by about 0.7 °C.
- Sea level around the UK rose by about 1 mm/yr in the 20th century, corrected for land movement. The rate for the 1990s and 2000s has been higher than this.
- The annual number of days with air frost has reduced in all regions of the UK between 1961 and 2006. There are now typically between 20 and 30 fewer days of air frost per year, compared to the 1960s, with the largest reductions in northern England and Scotland.[12]

The UK Climate Impacts Programme has modelled climate projections for regions across the UK at various probability levels. It is expected that by 2080, summer temperatures in the East of England will rise by between 1.9C and 5.9C with the most likely scenario being an increase of 3.6C. Winter precipitation is expected to rise between 4 per cent and 44 per cent with the most likely scenario being an increase of 20 per cent. Predictions for summer precipitation vary: possible scenarios include an increase in summer rainfall of 6 per cent or a decrease of 45 per cent with the most likely scenario being a decrease of 21 per cent.[13]

It is important to note that it is likely the future climate will be characterised by freak and severe weather events rather than incremental changes, that is we are more likely to see an increase in floods, droughts and storms rather than a gradual move to a Mediterranean climate.

Current climate change adaptation measures in place include:

- Solar shading – to reduce building temperatures
- The Campus Farm – to provide a source of cheap, local food

The Carbon Management Plan proposes that an assessment of the University's exposure to future climate change be undertaken by Academic year 2014/15 and a climate adaptation strategy & implementation plan be produced.

9.0 MONITORING AND REPORTING

The University is required to report annually on its emissions via Estates Management Statistics to the Higher Education Statistics Agency (HESA) and its scope 1 & 2 emissions to the Environment Agency in order to comply with our CRC obligations. The University also responds to the People & Planet Green League, a Freedom of Information requested survey of all higher education institutions.

The CMP recommends the purchase of comprehensive automatic monitoring and reporting technology (AMR), which would provide real time updates on carbon emissions to Estates Management staff but also, via the University webpage, to all students and staff. Using AMR technology helps raise awareness of our carbon impact and allows Estates staff to more effectively deploy carbon reduction measures to where they will be most effective.

Formal reporting of progress on the CMP has been detailed in the Governance section below.

10.0 GOVERNANCE

The overall responsibility for the delivery of the Carbon Management & Implementation Plan rests with the Director of Estate Management whilst the Energy Manager will lead on the delivery of the infrastructure elements of the plan, the Transport Policy Coordinator will lead on the delivery of the transportation (including commuting, business travel and relocation to University) elements of the plan and the Carbon Change Advisor will lead on programme management of the entire carbon change programme and the delivery of behavioural change measures, non-transport scope 3 measures and monitoring, reporting and coordination of the CMP.

The implementation plan is ambitious, and whilst it is achievable, can only be realised by putting carbon management at the heart of the University's operational and decision-making processes. As such it is essential that an appropriate carbon governance structure is set up to allow this to happen. It is essential that all faculties and departments play an active role in supporting various carbon reduction initiatives. The key recommendation is the establishment of a Carbon Management Team, headed by the Director of Estate Management which has representation from all key stakeholder groups, to oversee the implementation of the CMP.

12 http://www.ukcip.org.uk/essentials/climate-trends/
13 http://www.ukcip.org.uk/essentials/uk-impacts/key-findings/

10.1 Continuous improvement

The University recognises the need for on-going refinement of the Carbon Management Plan. The table below sets out the currently envisaged milestones for on-going review of the plan.

Measure	Objective	Date
I-lab session	To gain insight into the plan from across staff and student community and identify further carbon reduction measures	Dec-13
Reporting	To provide updates to the Carbon Management Implementation Committee	Termly
Projection revisions	To update the CMP based on new data garnered from termly reports	Jul-14
Implementation plan for scope 3 emissions	To update the CMP to include measures covering all emissions scopes	Jul-14
Annual report	To update staff and students regarding progress on the CMP and changes to implementation plan	Aug-14
Produce climate adaptation strategy	To ascertain exposure to climate change and severe weather events	Dec-14

Table 11

11.0 RECOMMENDATIONS

This CMP requests approval for the measures outlined in tables 6, 7, 8 & 9 and in line with its commitment to reduce carbon emissions by 43 per cent, by 2020 on a 2005 baseline. And recommends that the University:

1. Make available funding in phases to support the delivery of the full CMP and including at this stage funding for the first two years of the programme and funds to explore the feasibility of the gas fired CHP and other low carbon electricity generation projects and standards and projects for refurbishing the main campus buildings. At this stage a budget figure of ££3,706,824 (including VAT & professional fees) is required for the first two years of the programme. This covers IT upgrades, ventilation rationalisation, solar PV installation and behavioural change measures. We are not currently requesting the full £19,934,376 (including VAT & professional fees). It will be planned that the proposed measures are implemented as per the timescales outlined in tables 6, 7 and 8.
2. Implement the policy measures 5.3.6 to 5.3.8 to ensure future growth in the University's research, teaching and support operations does not come at the expense increased carbon emissions.
3. Review the recording of the purchase of goods and services, ensuring that all purchases are made to appropriate cost codes, allowing for the correct categorisation of University spending and improved management of emissions from this footprint area.

A further addendum and update paper including recommendations for emissions reductions from transport and other scope 3 emissions will be presented by the end of academic year 2013/14.