



Anglia Ruskin
University

Cambridge & Chelmsford

Carbon & Energy Management Plan 2010-2015

January 2011

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Acronyms & Abbreviations

CHP	Combined Heat & Power
CRC EES	Carbon Reduction Commitment Energy Efficiency Scheme
DEC	Display Energy Certificates
HEFCE	Higher Education Funding Council for England
ICT	Information & Communication Technologies
tCO2	Tonnes of carbon dioxide

1. INTRODUCTION

By providing higher education to students from across the world, investment in the future is core business for Anglia Ruskin University (ARU). This is reflected in the importance attached to sustainability by ARU and its inclusion amongst the six values declared in the Corporate Plan 2009-2011:

“Concern for the environment

We want our concern for a sustainable environment to inform every aspect of what we do”¹.

ARU has made significant progress improving its environmental performance, evidenced by a certified ISO 14001 Environmental Management System, high ranking in both the People and Planet Green League of universities² and Business in the Community Universities that Count initiative³, and an excellence award for its travel plan⁴.

Nevertheless, ARU is committed to continual improvement in its environmental performance and recognises that climate change represents a particularly challenging issue. Carbon dioxide emissions generated by the energy consumed on ARU campuses and travel between them contributes towards global climate change, and ARU has for several years acted to address this challenge including through participation in the 2008 Carbon Trust Higher Education Carbon Management Programme⁵.

This Carbon & Energy Management Plan aims to build on achievements to date and to specifically address the following additional issues.

- **ARU Corporate Plan commitment** to “Design and implement strategies specifically to reduce our environmental impact and to improve our energy efficiency focussing on staff and student engagement, detailed energy monitoring and clear communications” and by December 2011 “national benchmarking will show us to have exceptional staff and student engagement and to have been outstandingly successful in energy saving”⁶.
- **ARU Estate Strategy** objectives to “Plan for an environmentally, socially and financially sustainable estate” and “Meet the requirements for carbon reduction”⁷.
- **HEFCE** announcement in 2008 that from 2011 capital allocations will be linked to carbon reduction, with detailed requirements for carbon management plans published in January 2010.⁸
- Recommendations of a value for money **internal audit of energy management**⁹.

2. ENERGY POLICY & MANAGEMENT

ARU has a certified ISO 14001 environmental management system including an environmental policy statement approved by the Board of Governors, presented in Figure 1. This sets out the overall intentions and direction of the organisation related to its environmental performance, including energy management.

The environmental management system includes provision for assessing environmental risks, prioritising environmental aspects and delivering performance improvement actions, including allocation of responsibilities and resources. To avoid duplication, carbon reduction and energy management at ARU will be progressed under the auspices of the environmental management system.

3. AIMS

This Carbon & Energy Management Plan establishes a framework for action to deliver the following aims:

1. reduce scope 1 & 2 carbon emissions from ARU activities from a 2005-06 baseline by:
 - 27% by 2014-15
 - 43% by 2020-21
 - 83% by 2050-51
2. reduce energy costs.

4. CONTEXT

ARU has mirrored the substantial growth in the higher education sector over recent decades. Since 2005 student numbers and total floor space at ARU have risen by approximately 10%, and total energy costs have risen from £953,000 to over £1.6 million. Figure 2 indicates that whilst carbon emissions have remained relatively stable or fallen relative to the recent increases in floor space, staff and student numbers and university income, total energy spend has risen by over 80% relative to total floor space and over 100% relative to staff and students numbers.

Figure 1: ARU Environmental Policy Statement

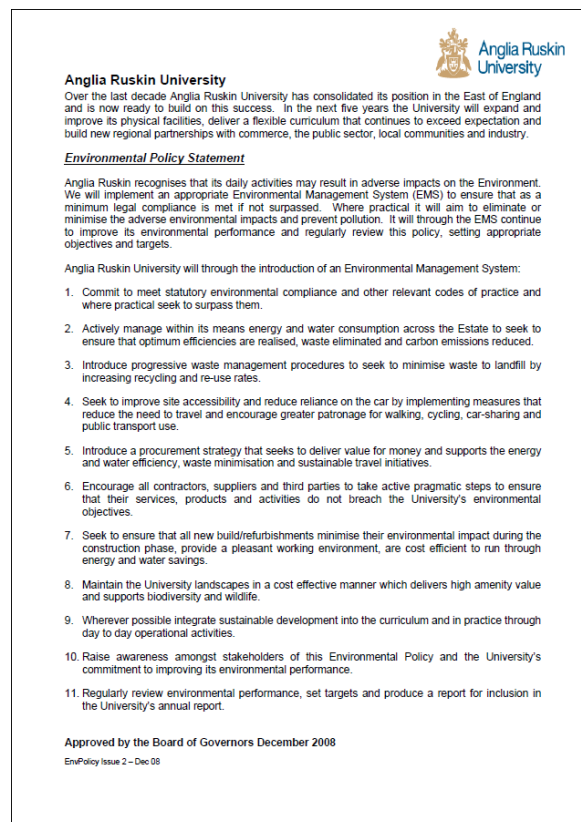
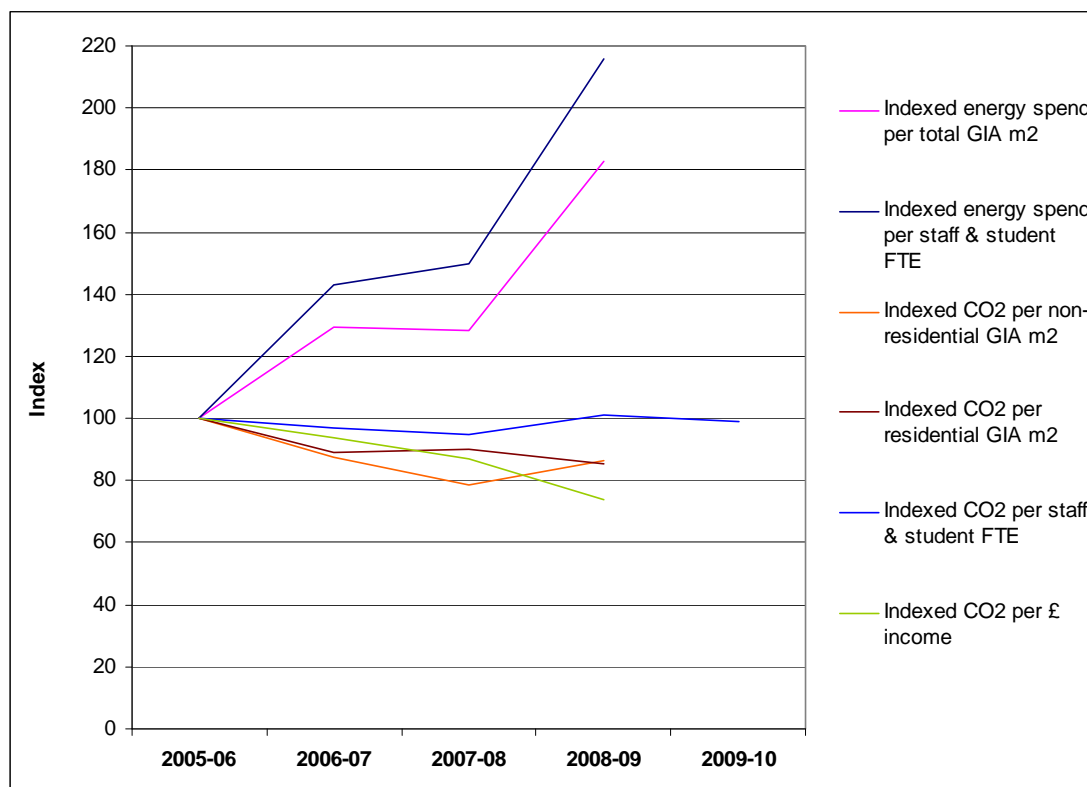


Figure 2: Energy & CO2 performance indices 2005-10

The contextual trends which this Carbon & Energy Management Plan is designed to address can be summarised as follows.

Regulation – the national and international regulatory framework to control carbon emissions has grown significantly since the early 1990's, which has imposed increasing energy and carbon management requirements on organisations. Recent years have seen the introduction of Display Energy Certificates and requirements for testing of air conditioning plant, and changes to the Carbon Reduction Commitment Energy Efficiency Scheme (CRC EES) in 2010 will increase its financial implications for ARU from a plus or minus £10,000 incentive to a £100,000 additional cost based on carbon emissions. This cost will be directly proportional to the energy consumed by Anglia Ruskin University. Given the carbon reduction commitments expressed by the UK Government and European Union, regulatory pressure for carbon reduction can be expected to increase in future.

Financial cost – in addition to the aforementioned cost of the CRC EES which represents an equivalent 6-7% increase in energy costs, Figure 2 shows that total energy spend since 2005 has increased by over 80% relative to total floor space and over 100% relative to staff and student numbers. Given predictions for global peak oil production to occur within the next 5 years¹⁰, the increased reliance of the UK on foreign and relatively unstable energy suppliers, and the carbon reduction investment needed in the UK energy infrastructure, most analysts predict that future UK energy prices are likely to increase. Section 7 below provides further

analysis of the estimated costs and savings associated with carbon reduction for Anglia Ruskin.

Corporate Social Responsibility – in order to avert increasing risks to people, property, the economy and environment in future, global governments, the European Union, the UK Government, businesses and many other institutions have committed to reduce carbon emissions which contribute towards climate change. ARU is committed to play a leading part in this endeavour, as expressed in its Corporate Plan, and aims to maintain its leading position in both the People and Planet Green League of universities and Business in the Community Universities that Count initiative.

5. CARBON BASELINE & REDUCTION TARGETS

From 2011 the HEFCE Capital Investment Framework requires higher education institutions to produce and maintain a carbon management plan with a 2005 carbon baseline. Figure 3 illustrates the scope 1 & 2¹¹ carbon emissions of ARU between 2005 and 2010 as well as the target level of emissions for 2014, 2020 and 2050, and Appendix A provides the associated data. This shows that carbon emissions fell by 10% from 8,707 tonnes in 2005 to 2006 but have increased every year since with carbon emissions in 2009 only 2% below the 2005 baseline at 8,528 tonnes.

Figure 3: ARU scope 1 & 2 carbon emissions 2005-10 & 2014, 2020 & 2050 reduction targets

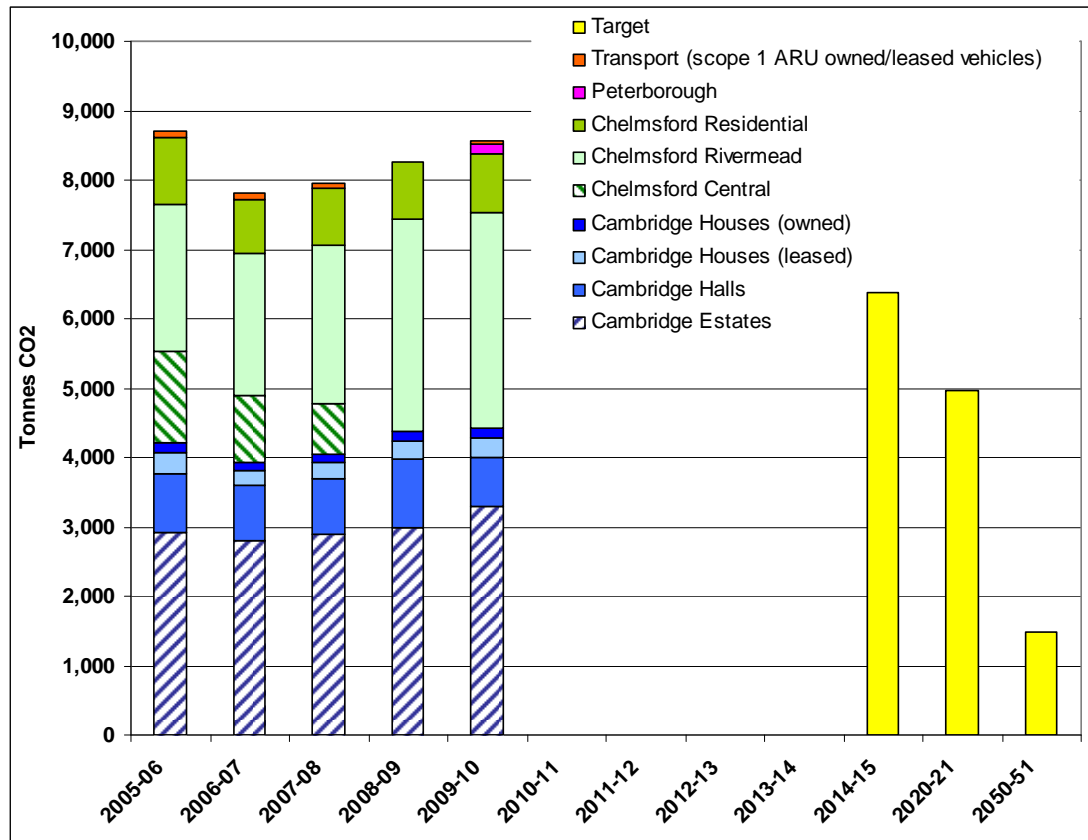
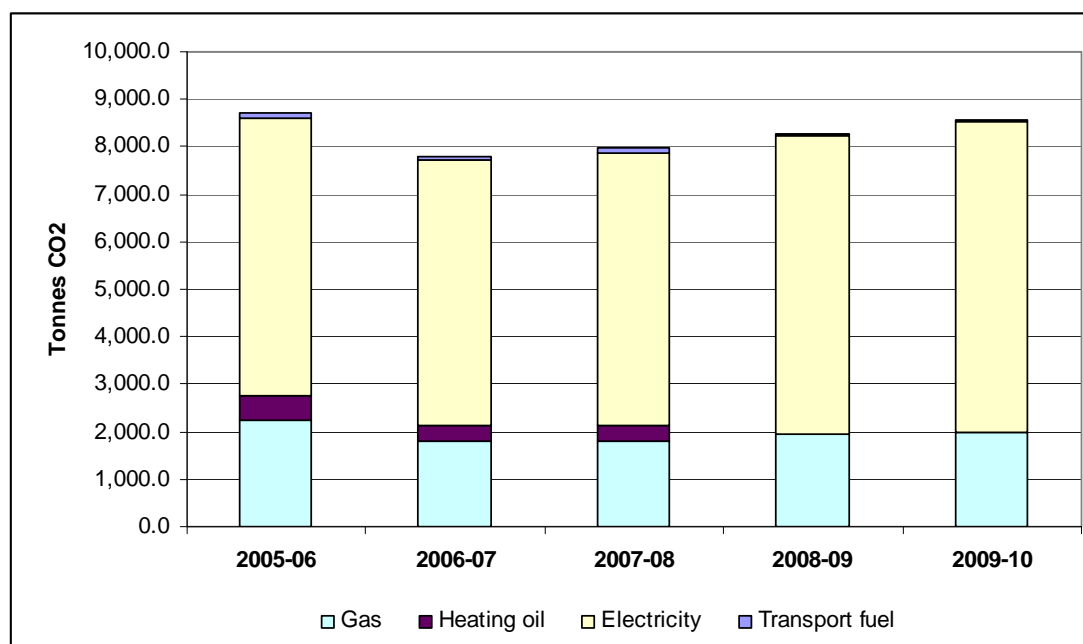


Figure 4 illustrates carbon emissions by fuel source between 2005 and 2010, which indicates that emissions from heating fuels (gas and heating oil) have fallen by 28% since 2005 whereas emissions from electricity have risen by 12% over the same period. Given that power consumption for lighting is unlikely to have increased significantly over this period, this increased consumption is most likely to be due to ICT and other equipment.

Figure 4: ARU scope 1&2 carbon emissions by fuel source 2005-10



In 2008 ARU participated in the Carbon Trust Higher Education Carbon Management Programme to develop a carbon baseline and action programme, including a target to reduce carbon emissions by 20% by 2014-15 from a 2007-08 baseline. However, as this work excluded certain scope 1 vehicle emissions, included scope 3 water and waste emissions and adopted a different baseline, Table 1 updates these carbon reduction targets to meet the requirements and ambition of HEFCE.

Table 1: ARU scope 1 & 2 carbon reduction targets 2014, 2020 & 2050

Year	2005-06 Baseline	2014-15	2020-21	2050-51
Total scope 1&2 tCO2 emissions	8,707.2	8,527.6	6,369.1	4,963.1
% CO2 savings target		27% ¹²	43%	83%

6. ACTION PLAN

ARU has for several years implemented measures to reduce energy consumption and carbon emissions, including those identified through working

with the Carbon Trust Higher Education Carbon Management Programme listed in Appendix B. This shows that up to 2009-10, energy saving measures contributed towards reducing carbon emissions by over 470 tonnes per year. If all future projects were implemented and achieved their estimated carbon savings they would collectively save 1,921 tonnes of CO₂ per year by 2014-15 representing a 24% reduction in carbon emissions from a 2005-06 baseline, 282 tonnes short of the 27% reduction target (provided additional energy consumption due to growth of the estate remained neutral).

It should be noted however that 1,000 tonnes of the savings included in Appendix B are to be delivered by CHP installations at Cambridge and Chelmsford, which are still at the early stages of feasibility appraisal.

In addition to progressing those projects listed in Appendix B, Table 2 presents a strategic carbon and energy saving action plan for ARU covering energy management, efficiency, awareness, procurement, estate development and project appraisal.

Table 2: Carbon & energy saving action plan

Action	Responsibility	Timescale
1. Energy management		
1.1 Incorporate the aims and actions of this Carbon & Energy Management Plan within the next review of the <u>ISO 14001 environmental management system</u> policy and action plan.	Environment Team	2010-11
1.2 Improve building scale <u>energy monitoring & targeting</u> by integrating existing half hourly sub-meters with existing energy management software.	Environment Team	2010-11
1.3 Utilise improved half hourly building energy data to <u>monitor building performance</u> using a range of metrics (£/m ² , kWh/m ² , kWh/staff & student FTE) enabling prioritisation of buildings for improvement work.	Environment Team	2010-11
1.4 Improve energy performance monitoring and forecasting by establishing an <u>energy projects and opportunities register</u> detailing changes to consumption, costs and CO ₂ emissions identified through energy surveys, Building Management System monitoring, DEC and air conditioning plant assessments, and the ARU Sustainability Committee.	Building Services supported by Environment Team	2010-11

Action	Responsibility	Timescale
1.5 Identify additional projects for <u>Salix funding</u> and other external funding streams as appropriate.	Building Services supported by Environment Team	2011 onwards
1.6 <u>Compliance</u> with relevant legislation will be assured through maintenance of the ISO 14001 legal register, including the Energy Performance of Buildings Directive and CRC EES.	Environment Team	Ongoing
1.7 Incorporate <u>progress reporting</u> towards achievement of carbon saving targets with quarterly and annual reports of the ISO 14001 environmental management system.	Environment Team	2010 onwards
2. Energy efficiency		
2.1 Progress delivery of projects added to the energy projects and opportunities register assessed to be viable, including those identified through the <u>Carbon Trust Higher Education Carbon Management Programme</u> listed in Appendix B.	Building Services	2010 onwards
2.2 Strengthen the utilisation of <u>Building Management Systems</u> at both Cambridge and Chelmsford campuses to optimise building energy utilisation and monitor performance.	Building Services	2010 onwards
2.3 Investigate options for introducing a <u>financial incentive</u> for faculties and services to reduce energy consumption.	Environment Team	2011-12
3. Energy awareness		
3.1 Adoption of responsible energy behaviours will be promoted through relevant <u>campaigns</u> , including Student Switch Off and Green Impact Universities.	Sustainability Committee & Environment Team	Yearly
3.2 Investigate installation of <u>real time energy consumption displays</u> in university public areas and/or website.	Environment Team	2011-12

Action	Responsibility	Timescale
3.3 Identify additional <u>energy savings opportunities</u> in key university faculties and services including maintenance and Information Technology.	Sustainability Committee, Building Services & Environment Team	2011 onwards
3.4 Energy saving awareness and action will be promoted through integration in ISO 14001 <u>training and communications</u> programme, staff induction and other appropriate university events.	Environment Team supported by Building Services	2010 onwards
4. Energy procurement		
4.1 Secure most advantageous energy prices by adopting <u>flexible purchasing policies</u> for all electricity and gas contracts.	Environment Team	2010-11
4.2 Improve the efficiency of utility bill checking by adopting <u>electronic EDI billing</u> (subject to supplier capability) integrated with existing energy management software.	Environment Team	2010-11
5. Estate development		
5.1 All new university developments will aim to achieve at least <u>BREEAM 'Very Good' standard</u> or higher where resources allow.	Projects supported by Building Services	2010 onwards
5.2 Improve new building handover and efficient operation through early integration into the <u>commissioning process</u> .	Building Services	2010 onwards
5.3 Opportunities for installing <u>onsite low and zero carbon energy generation</u> will be progressed where it is assessed to be financially viable.	Building Services supported by Environment Team	2010 onwards
5.4 <u>Design guidance</u> will be developed specifying the energy requirements of building upgrades and refurbishments.	Building Services	2010 onwards
6. Project appraisal		
6.1 Energy and CO2 impacts and savings opportunities of all new projects will be assessed through adoption of an <u>Environmental Risk Assessment</u> .	Building Services supported by Environment Team	2010-11

7. ESTIMATED COSTS & SAVINGS

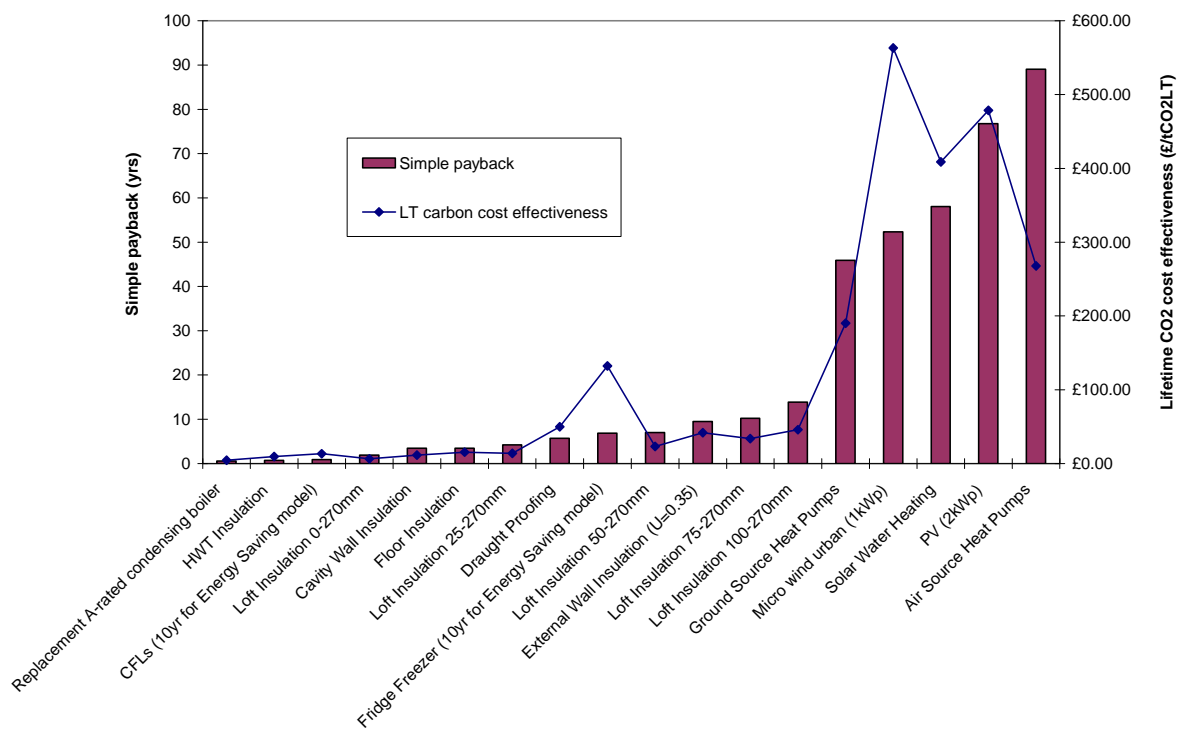
Generating carbon emissions through consumption of power, gas and fuel costs ARU money: every tonne of CO2 emitted through consumption of gas costs £162, electricity £202, diesel £483 and unleaded petrol £518¹³. From 2011 these costs will rise by £12 per tonne with the introduction of the CRC EES.

Conversely, there are many viable carbon reduction investments which cost less than these amounts per tonne of CO2 saved which will deliver financial savings to ARU. Investment in many of these projects will provide energy savings payback in less than two years and continue to provide significant cost savings long term.

The national Salix scheme for ring-fenced and revolving loan investment in public sector carbon reduction uses a threshold of £100 per tonne of CO2 saved over the lifetime of a project below which investments should be prioritised. Figure 5 illustrates the value for money in terms of cost per tonne of CO2 saved and simple financial payback for a range of energy measures, illustrating that many energy efficiency projects fall well below the £100/tCO2 threshold.

Figure 5 also illustrates that renewable energy projects cost in the order of £300/tCO2 or above, indicating that energy efficiency measures should be prioritised for the immediate future and renewable energy projects will require significantly more, or alternative forms of, investment.

Figure 5: Carbon and financial value for money of energy measures



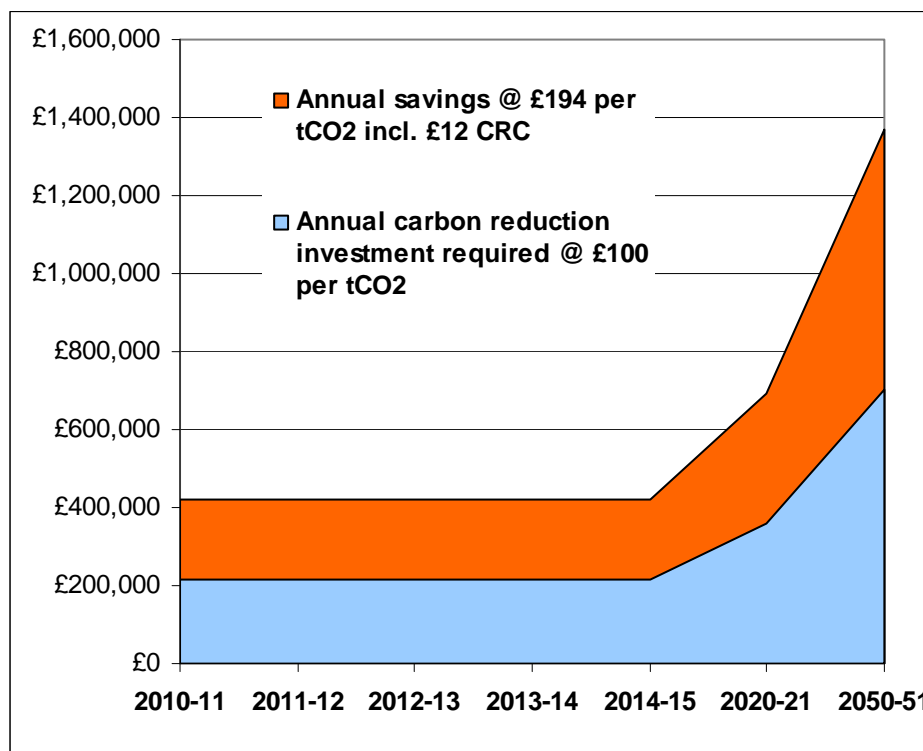
Many measures will need to be implemented in order for ARU to achieve its carbon reduction targets for 2014, 2020 and 2050 in addition to those listed in

Appendix B. An indication of the cost to ARU of achieving these targets may be gained by adopting the £100 per tonne of CO₂ saved figure, and the savings by adopting an average cost of £194 per tonne of CO₂ from electricity and gas consumption including £12 per tonne from the CRC EES. The estimated annual costs, gross and net savings are presented in Table 3 and their cumulative profile illustrated in Figure 6.

Table 3: Estimated annual costs, gross and net savings from carbon reduction measures

Period	Annual Cost	Gross Annual Savings	Net Annual Savings
Up to 2014	£215,847	£418,743	£202,896
2014 – 2020	£356,448	£691,509	£335,061
2020 - 2050	£704,735	£1,367,186	£662,451

Figure 6: Cumulative costs & savings from carbon reduction measures up to 2014, 2020 & 2050



It should be noted that this investment is required solely to pay for carbon reduction rather than energy related repairs and renewals investment: for example, this money should be invested in the additional cost associated with replacing a gas boiler with a more efficient new one instead of a like for like replacement, rather than the entire cost of the new boiler.

Budgets for the required investment in carbon reduction will be identified from the following sources:

- ARU revenue and capital budgets.
- Salix loan funding and other external funding streams.
- Assessment of alternative funding mechanisms such as energy performance contracting or energy service company funding.

8. RESPONSIBILITIES, MONITORING & REPORTING

Implementation of this Carbon & Energy Management Plan will be progressed under the auspices of the ISO 14001 environmental management system in order to avoid establishing duplicate responsibility, monitoring and reporting arrangements.

The Environment Manager will be responsible for reporting progress with implementation of this Carbon & Energy Management Plan to the Sustainability Group, Corporate Management Team and Board of Governors.

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Appendix A ARU carbon emissions 2005 to 2010

The following table presents ARU carbon dioxide emissions between 2005 and 2010 calculated in accordance with the requirements detailed in HEFCE, *Carbon Management Strategies & Plans, A guide to good practice*, January 2010/02 (Updated September 2010). Additional data is presented which has been used for analysis in this Carbon & Energy Management Plan.

	2005-06	2006-07	2007-08	2008-09	2009-10
Scope 1&2 tCO2 emissions					
Cambridge Estates	2,928.8	2,797.3	2,893.6	2,990.4	3,305.4
Cambridge Halls	834.3	796.4	804.7	979.7	688.0
Cambridge Houses (leased)	318.8	215.6	220.2	273.6	298.4
Cambridge Houses (owned)	134.7	125.7	132.5	142.4	131.9
Chelmsford Central	1,317.6	960.1	734.3	0.0	0.0
Chelmsford Rivermead	2,122.9	2,040.2	2,280.9	3,049.7	3,100.3
Chelmsford Residential	963.8	793.7	816.3	813.3	843.0
Peterborough					160.5
Transport (scope 1 ARU owned/leased vehicles) ¹⁴	86.2	77.3	78.8	15.5	45.2
Total scope 1&2 tCO2 emissions	8,707.2	7,806.2	7,961.4	8,264.5	8,527.6
Actual % reduction (2005-06 baseline)	Baseline	10%	9%	5%	2%
Total energy spend	£952,962	£1,261,487	£1,376,184	£1,932,110	£1,601,399
Non-residential tCO ₂	6,369.3	5,797.5	5,908.8	6,040.1	6,566.2
Residential tCO ₂	2,251.6	1,931.4	1,973.8	2,208.9	1,961.4
Non-residential GIA m ²	70,572.0	73,616.0	83,299.0	77,264.0	77,264.0
Residential GIA m ²	24,572.0	23,707.0	23,883.0	28,278.0	
Student FTE	14,250.7	13,115.4	13,735.1	13,300.9	15,640.0
Staff FTE	1,560.0	1,506.0	1,523.0	1,556.0	
Total income	£115,798,000	£110,450,000	£122,021,000	£148,844,000	
Scope 3 tCO2 emissions (HEFCE guidance requires a carbon baseline covering only scope 1 & 2 emissions).					
Business mileage	No data available				
Commuting					
Air travel					
Water	NO GHG conversion factor		24.5	25.4	22.8
Waste	NO GHG conversion factor				

Note on carbon conversion factors

Conversion factors used to convert amounts of energy and fuel consumed into amounts of carbon dioxide emitted are published by the UK Government on the following web page.

<http://www.defra.gov.uk/environment/business/reporting/conversion-factors.htm>

As these conversion factors are updated at least annually and vary by coverage of scope 1, 2 and 3 emissions, different conversion factors can be required for different purposes. The following table clarifies which conversion

factors have been used in this Carbon & Energy Management Plan, which it should be noted are different to those required by the Higher Education Statistics Agency Estate Management Statistics.

Purpose	Guidelines to Defra / DECC's Greenhouse Gas Conversion Factors for Company Reporting		
	Electricity	Gas	Fuel oil
Carbon baselines for individual Higher Education Institutions in England, Report to HEFCE by SQW, August 2010	Version Aug 2010; Annex 3 Table 3c Grid Rolling Average Scope 2, 3 Total Direct GHG	Version Aug 2010; Annex 1 Table 1c Gross CV Basis Scope 1 Total Direct GHG	Version Aug 2010; Annex 1 Table 1c Gross CV Basis Scope 1 Total Direct GHG
Estate Management Statistics 2010	Version Oct 2010; Annex 3 Table 3c Grid Rolling Average Scope 2, 3 CO2	Version Oct 2010; Annex 1 Table 1d Net CV Basis Scope 1 CO2	Version Oct 2010; Annex 1 Table 1d Net CV Basis Scope 1 CO2
HEFCE, Carbon Management Strategies & Plans, A guide to good practice, January 2010/02 (Updated Sept 2010)	Version Aug 2010; Annex 3 Table 3c Grid Rolling Average Scope 2, 3 Total Direct GHG	Version Aug 2010; Annex 1 Table 1c Gross CV Basis Scope 1 Total Direct GHG	Version Aug 2010; Annex 1 Table 1c Gross CV Basis Scope 1 Total Direct GHG
This Carbon & Energy Management Plan	Version Oct 2010; Annex 3 Table 3c Grid Rolling Average Scope 2, 3 Total Direct GHG	Version Oct 2010; Annex 1 Table 1c Gross CV Basis Scope 1 Total Direct GHG	Version Oct 2010; Annex 1 Table 1c Gross CV Basis Scope 1 Total Direct GHG

Appendix B ARU projects identified through the Carbon Trust Higher Education Carbon Management Programme

PROJECTS	Estimated carbon savings per year (tCO2)					
	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
HECM PROJECTS						
001: Upgrade of boiler controls Cambridge	121.0	121.0	121.0	121.0	121.0	121.0
002: Centralised printing Chelmsford	7.0	7.0	7.0	7.0	7.0	7.0
003: Trial of Waterless Urinals Chelmsford	0.2	0.2	0.2	0.2	0.2	0.2
004: Installation of Dyson Hand driers/removal of paper towels	16.4	16.4	16.4	16.4	16.4	16.4
005: Installation of aMR (sub metering on both sites)	292.0	292.0	292.0	292.0	292.0	292.0
006: Fuelstretcher Technology for Mumford Boilers	18.6	18.6	18.6	18.6	18.6	18.6
007: Helmore Street (disable architectural down lighters)	7.7	7.7	7.7	7.7	7.7	7.7
008: Centralised waste and recycling bins open plan areas	Scope 3 savings don't contribute towards savings target					
009: Re-roofing David, Helmore, Ruskin	9.0	9.0	9.0	9.0	9.0	9.0
010: Lighting Upgrades & Presence Detectors Chelmsford (William Harvey, & Mildmay)		84.0	84.0	84.0	84.0	84.0
011: Lighting Upgrades Cambridge (Helmore, Mumford & David)		37.0	37.0	37.0	37.0	37.0
012: Fuelstretcher phase 1 Chelmsford	Referenced under Salix projects below.					
013: Fuelstretcher phase 2 Cambridge			60.0	60.0	60.0	60.0
014: Lighting Upgrades Cambridge (Eastings, Sinclair, Ruskin, Webb, Mellish Clarke)			17.0	17.0	17.0	17.0
015: Lighting Upgrades Chelmsford (Queens, Ashcroft, Rivermead Gate)			61.5	61.5	61.5	61.5
016: BMS controls improvements			35.3	35.3	35.3	35.3

PROJECTS	Estimated carbon savings per year (tCO2)					
	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
017: William Harvey Boiler Insulation			2.1	2.1	2.1	2.1
018: Peter Taylor TRV				2.0	2.0	2.0
019: Swinhoe TRV				1.2	1.2	1.2
020: Tindal Heating Zones				2.3	2.3	2.3
021: Ashcroft Heating Zones				2.3	2.3	2.3
022: Gas CHP Cambridge				500.0	500.0	500.0
023: Gas CHP Chelmsford				500.0	500.0	500.0
HECM SAVINGS	471.9	592.9	768.8	1,776.6	1,776.6	1,776.6
% Reduction (2005-06 baseline)		9%	11%	22%	22%	22%
SALIX PROJECTS						
Chelmsford: Smart Heat pipe, flange & valve insulation		21.8	21.8	21.8	21.8	21.8
Chelmsford: Fuelstretcher		14.7	14.7	14.7	14.7	14.7
Chelmsford: Voltage Reduction Equipment		83.6	83.6	83.6	83.6	83.6
Cambridge: Sotham pipe, flange & valve insulation		25.0	25.0	25.0	25.0	25.0
SALIX SAVINGS	0	145.03	145.03	145.03	145.03	145.03
TOTAL tCO2 SAVINGS	471.9	737.9	913.8	1,921.6	1,921.6	1,921.6
RESIDUAL CARBON FOOTPRINT (tCO2)	8,101	7,835	7,659	6,651	6,651	6,651
Target variance						282
% Reduction (2005-06 baseline)						24%

Notes

¹ ARU Corporate Plan 2009-2011, pg 1,

http://www.anglia.ac.uk/ruskin/en/home/your_university/about_anglia_ruskin/corporate_plan_2009-2011.html

² <http://peopleandplanet.org/greenleague>

³ <http://www.eauc.org.uk/utc>

⁴ <http://www.tfw.org.uk/news.php#TPAwards2010>

⁵ ARU & The Carbon Trust, *Draft Carbon Management Plan*, February 2009

⁶ ARU Corporate Plan 2009-2011, pg 21,

http://www.anglia.ac.uk/ruskin/en/home/your_university/about_anglia_ruskin/corporate_plan_2009-2011.html

⁷ ARU Estate Strategy 2010-15, pg 1.

⁸ HEFCE, *Carbon Management Strategies & Plans, A guide to good practice*, January 2010/02 (Updated September 2010)

⁹ Grant Thornton, Anglia Ruskin University Internal Audit Report, *Value for Money – Energy Management*, July 2010

¹⁰ UK Industry Taskforce on Peak Oil and Energy Security <http://peakoiltaskforce.net/>

¹¹ Scope 1 & 2 emissions refers to the Greenhouse Gas (GHG) Protocol for reporting emissions. Scope 1 refers to direct GHG emissions (e.g. generation of electricity, heat, or steam, transportation of materials, products, waste, and employees) and scope 2 refers to indirect GHG emissions through the use of grid electricity. Scope 3 refers to other indirect GHG emissions such as embodied carbon in purchased materials and fuels, employee business travel and waste disposal.

www.ghgprotocol.org/standards/corporate-standard

¹² A 27% reduction target from a 2005-06 baseline is equivalent to a 20% reduction target from a 2007-08 baseline.

¹³ Costs of carbon dioxide based on unit prices for gas of 3p/kWh; electricity 11p/kWh; diesel £1.27/litre and unleaded petrol £1.20/litre. Based on Defra carbon conversion factors updated Oct 2010.

¹⁴ Scope 1 emissions from ARU owned and leased vehicles between 2005 and 2008 are assumed to be 1% of total scope 1 and 2 emissions, as instructed by HEFCE, *Carbon Management Strategies & Plans, A guide to good practice*, January 2010/02 (Updated September 2010), table 2-2, pg 14.