THE UNIVERSITY OF WARWICK

2020 Carbon Management Implementation Plan
2016 Progress Update - Appendix
The University of Warwick

CARBON TRUST

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Contents

1. Purpose of this Document

This progress report on the Carbon Management Implementation Plan (CMIP) provides a single location for the reporting of all data relevant to the progress of the University towards its scope 1 and 2 carbon emissions target. The University is undergoing a holistic review of its Carbon plan and targets, this is expected to be completed during 2016. This document provides an update against the current plan and targets. The methodology for updating this document is described in the CMIP main document.

2. Scope 1 and 2 Emissions: Baseline, Historical Figures and Projections

2.1 Baseline and assumptions.

The following represents a summary of the direct Scope 1 carbon emissions produced by the University of Warwick in 2005-06:

Fuel Use	Main campus	HRI	Total	Emission Factor	Carbon Emission (tonnes)
Oil (kWh)	0	492,819	492,819	0.258	127
Gas (kWh)	131,992,705	12,506,525	144,499,230	0.185	**26,732**

Fleet Vehicles	Main campus	HRI	Total	Emission Factor	Carbon Emission (tonnes)
Number of vehicles	125	51	176	2*	**352**

** The fleet emissions are estimated as 352 tonnes CO_{2e} based upon a general 2 tonnes per vehicle per annum, the number of vehicles operating across the University and the previous estimate of fleet emissions calculated as part of the previous carbon management programme.*

In 2005-06, Scope 1 carbon emissions across the University of Warwick amounted to: 27,212 tonnes CO_{2e}.

The following represents a summary of the indirect Scope 2 carbon emissions associated with the use of bought-in (grid) electricity at the University of Warwick in 2005-06:

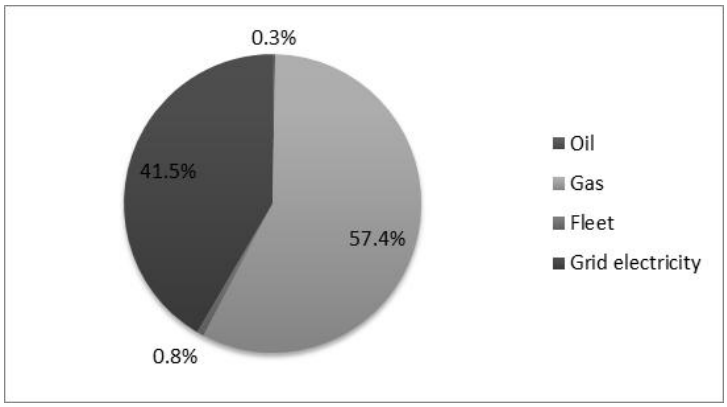
Electricity	Main campus	HRI	Total	Emission Factor	Carbon Emission (tonnes)
Grid Electricity (kWh)	29,899,372	7,347,640	37,247,012	0.481**	**17,931**

** Revised carbon emission factor (Transport and Distribution of Grid Electricity removed in line with HESA methodology) – average of 2005 and 2006 figures

In 2005-06, Scope 2 carbon emissions across the University of Warwick amounted to 19,328 tonnes CO_{2e}.

In 2005-06, Scope 1 and Scope 2 carbon emissions across the University of Warwick amounted to 45,142 tonnes CO_{2e}.

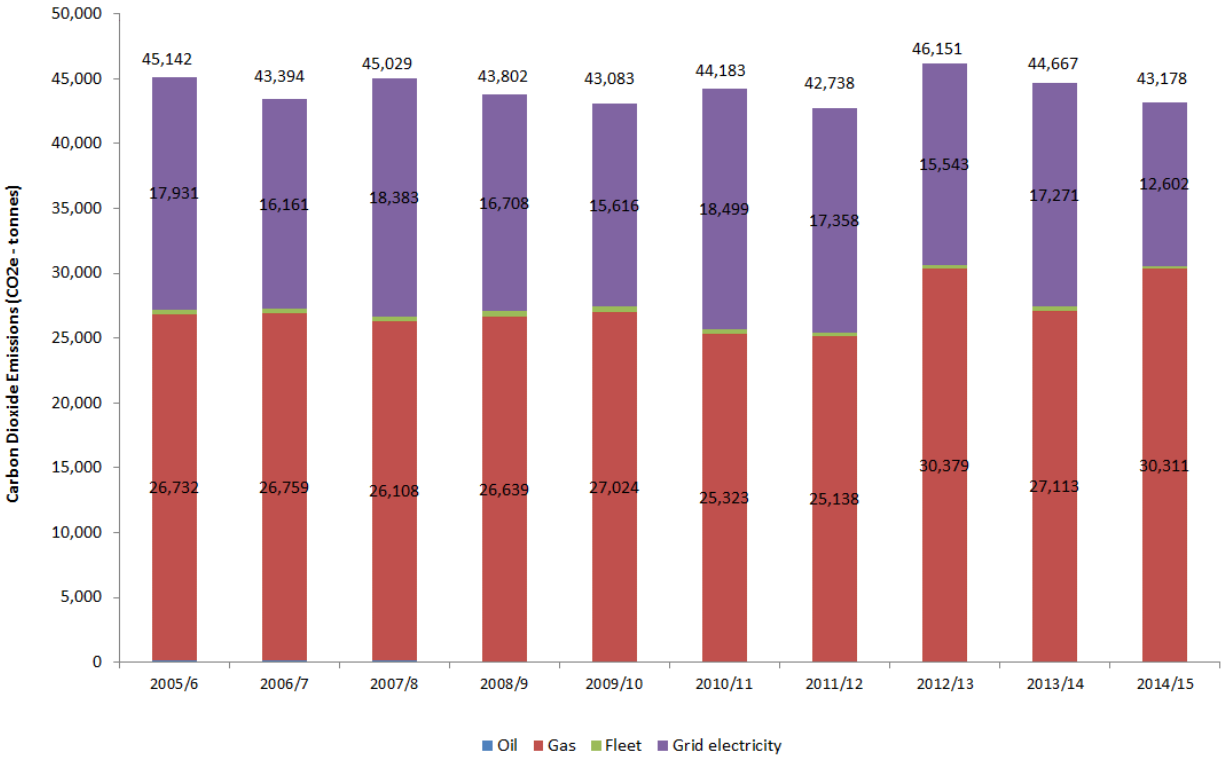
The following pie chart illustrates the composition of the scope 1 and 2 baseline carbon footprint from 2005-06 and shows that emissions from buildings dominate the fleet emissions:



Scope 1 and 2 carbon emissions 2005-06

2.2 Emissions from Baseline Year to Present.

Data compiled for scope 1 and 2 carbon emissions up to the last reporting year are provided, broken down by fuel type in Appendix 1, and shown graphically below.



A detailed commentary on the changes in energy consumption is provided in the Energy and Carbon report provided to the Estates Committee on 21 October 2015. The principle driver in the reduction of emissions between 2013/14 and 2014/14 was the completion of Cryfield energy centre. The increase in combined heat and power capacity has resulted in a reduction in grid electricity consumption (an increase in more carbon efficient electricity from co-generated power).

In 2014-15, Scope 1 and Scope 2 carbon emissions across the University of Warwick amounted to 43,178 tonnes $CO_{2e,}$ a decrease of 4.4% compared to the baseline year 2005/6.

Although target reductions are absolute, the relative efficiency of carbon emissions by the University should also be assessed. The following table presents the staff and student FTE and the University's income:

	2005/6	2006/7	2007/8	2008/9	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Staff and student FTE	21,046	20,890	21,814	22,626	24,119	25,069	25,685	25,402	25,928	26,151
Income £ 000	£310,601	£330,511	£350,181	£375,656	£408,500	£419,100	£440,100	£459,600	£480,500	£512,800
Floor Area (m^2)	439,550	467,463	460,789	482,110	455,754	456,060	477,299	488,640	488,017	506,504

The change in emissions in relative terms is illustrated in the following table:

	2005/6	2006/7	2007/8	2008/9	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Absolute Emissions (tonnes CO_{2e})	45,142	43,394	45,029	43,802	43,083	44,183	42,738	46,151	44,667	43,178
CO_{2e} per staff and student FTE	2.14	2.08	2.06	1.94	1.79	1.76	1.66	1.82	1.72	1.65
CO_{2e} per £1000 income*	0.118	0.110	0.111	0.103	0.096	0.098	0.092	0.097	0.092	0.084
CO_{2e} per m^2 floor area	102.70	92.83	97.72	90.85	94.53	96.88	89.54	94.45	91.53	85.25

* GDP Deflator applied

Note: in 2007/8 and 2010/11 one of the cogeneration units suffered a break down for several months. The consequence has been reduced self-generated electricity and larger import from the grid at higher carbon emissions content. Such events highlight the importance of the cogeneration and district heating in the delivery of the University Carbon Management Implementation Plan.

2.3 Campus Expansion

The data shown in the following table has been used to model the potential increase in carbon emissions and costs:

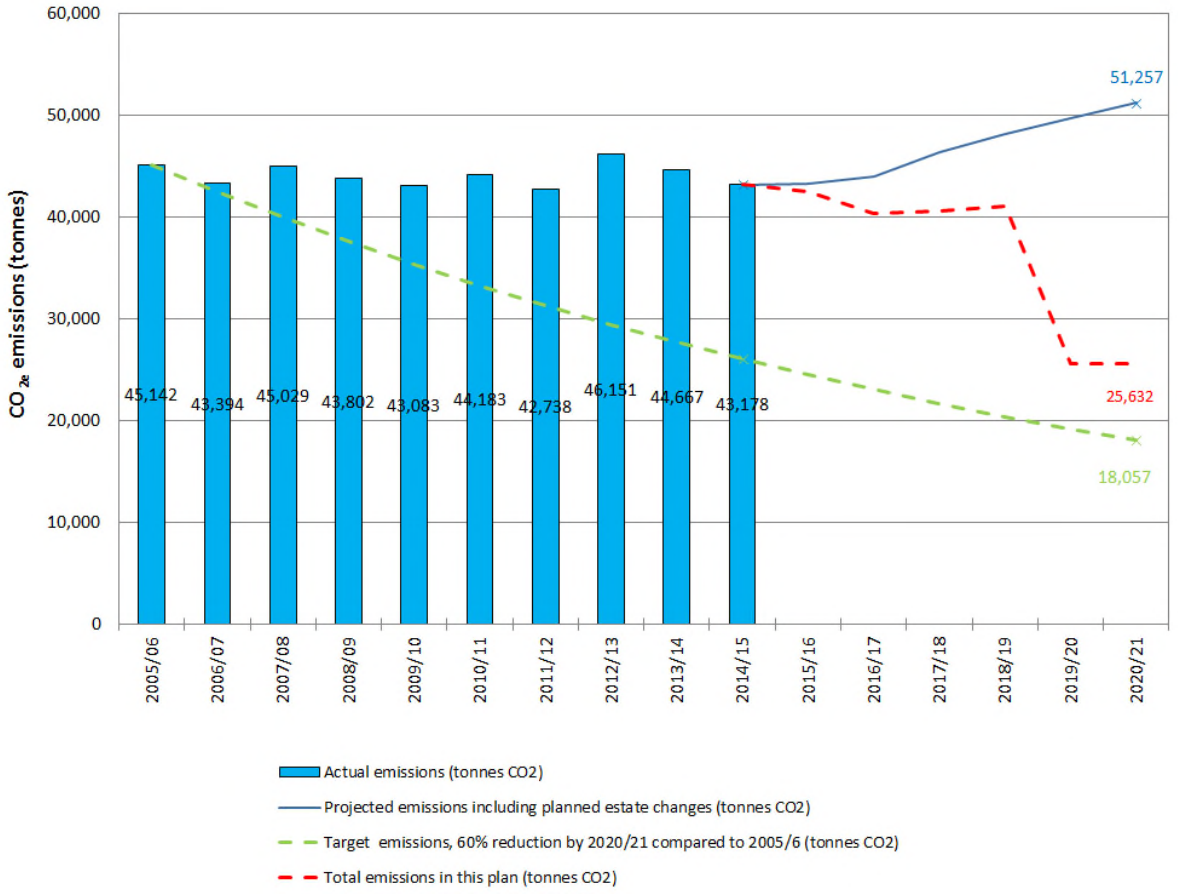
	Total additional Gross internal area (m^2) including residences (for utilities planning)**	CO_{2e} increase pa (tonnes)*
2015/16	1160	121
2016/17	8855	709
2017/18	34869	2,384
2018/19	19179	1,720
2019/20	15950	1,631
2020/21	19971	1,513

*Based on comparative existing buildings

**From Five Year Plan 2016, Estates Office: Growth Assumptions for direct cost budgets for 2014/15 to 2020/21.

2.4 Emissions projections

Using the assumptions for campus expansion, overall carbon emissions have been projected to 2020/21 as shown by the solid blue line in the following graph. The target emissions required if the University is to achieve its carbon reduction target are shown by the green dotted line. The University is undertaking a consultation to review the carbon target. The effect of the Carbon Reduction projects identified later in this plan is shown by the red dotted line.

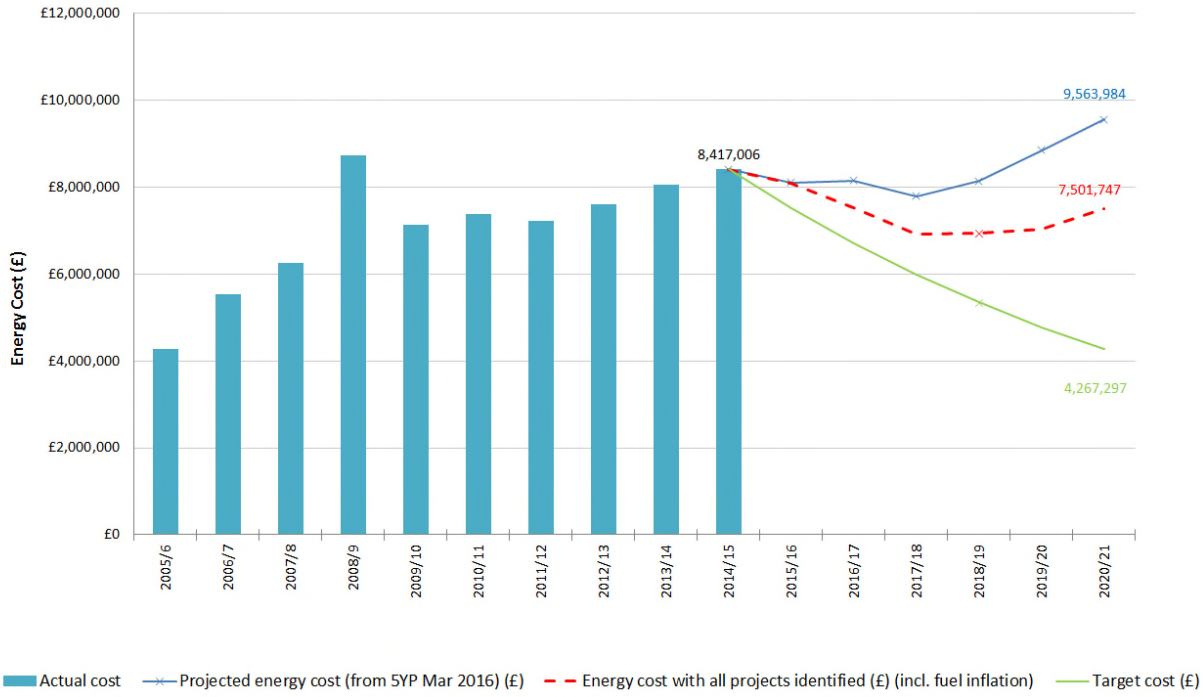


The emissions projections above estimate a growth in emissions to 51,257 tonnes CO_{2e} by 2020/21. Achievement of the emissions reduction target would correspond to emissions of only 18,057 tonnes CO_{2e}. Measures to reduce the carbon emissions of the existing buildings and their energy supply by about 33,200 tonnes CO_{2e} are predicted to be required to achieve the carbon reduction target.

If electricity supplied by the national grid reduces in carbon intensity by 2020/21 (due to increased low and zero carbon supply to the grid) the projected emissions accounting for planned estate changes will reduce. For the purpose of the report the predicted emissions and projected project savings are made using today's factors. If grid electricity carbon intensity reduces then the potential savings from projects reducing grid electricity consumption will also go down.

2.5 Value at stake

The chart below shows historical utilities costs, a projection of future costs and an illustration of potential savings. Estimates were made for the increases in energy cost resulting from the planned estate changes. This is shown by the blue line. The reduction in energy cost accounting for the reduction in consumption resulting from achieving the carbon reduction target and allowing for cost increases each year were also estimated, and shown by the green line. The energy cost projections associated with projects already identified in this plan are shown by the dotted red line. Figures used in this chart are provided in Appendix 2.



The cost of carbon taxes (CRC EES and EU ETS) is not included in this VAS calculation.

The graph shows that by 2020/21 the energy costs accounting for planned estate changes and price increases is estimated to be in excess of £9.5m but if the carbon reduction target is achieved these could be reduced to £4.2m Therefore the value at stake in achieving the carbon reduction target would correspond to an annual saving of over £5 million by 2020/21. Projects have already been identified that could provide an annual energy cost saving of approximately £2 million by 2020 over the business as usual projection. These projects are briefly described in section 2.

In addition to these cost increase there are additional charges related to energy consumption and carbon which are likely to also increase costs in future years:

- The European Emissions Trading Scheme (EU-ETS) requires that we purchase allowances for our carbon emissions. The market price for 2013/14 is estimated at £6/tonne CO_2 and, at least, is expected to increase in line with RPI;
- The Climate Change Levy is likely to increase and is predicted to do so at c.9% p.a.

- The University has been subject to a number of pass through charges from the Utilities companies that contribute to an expanding portion of the overall utilities bill. These charges relate to the transmission and distribution of power and recovery of costs related to the Feed in Tariff and Renewable Obligations schemes.

3. Carbon Management Projects

Successfully reducing the University's carbon emissions by the amount necessary to achieve the target will require the implementation of projects across all aspects of the University's activities. The measures are described and their cumulative effect shown.

3.1 Projects to reduce carbon emissions

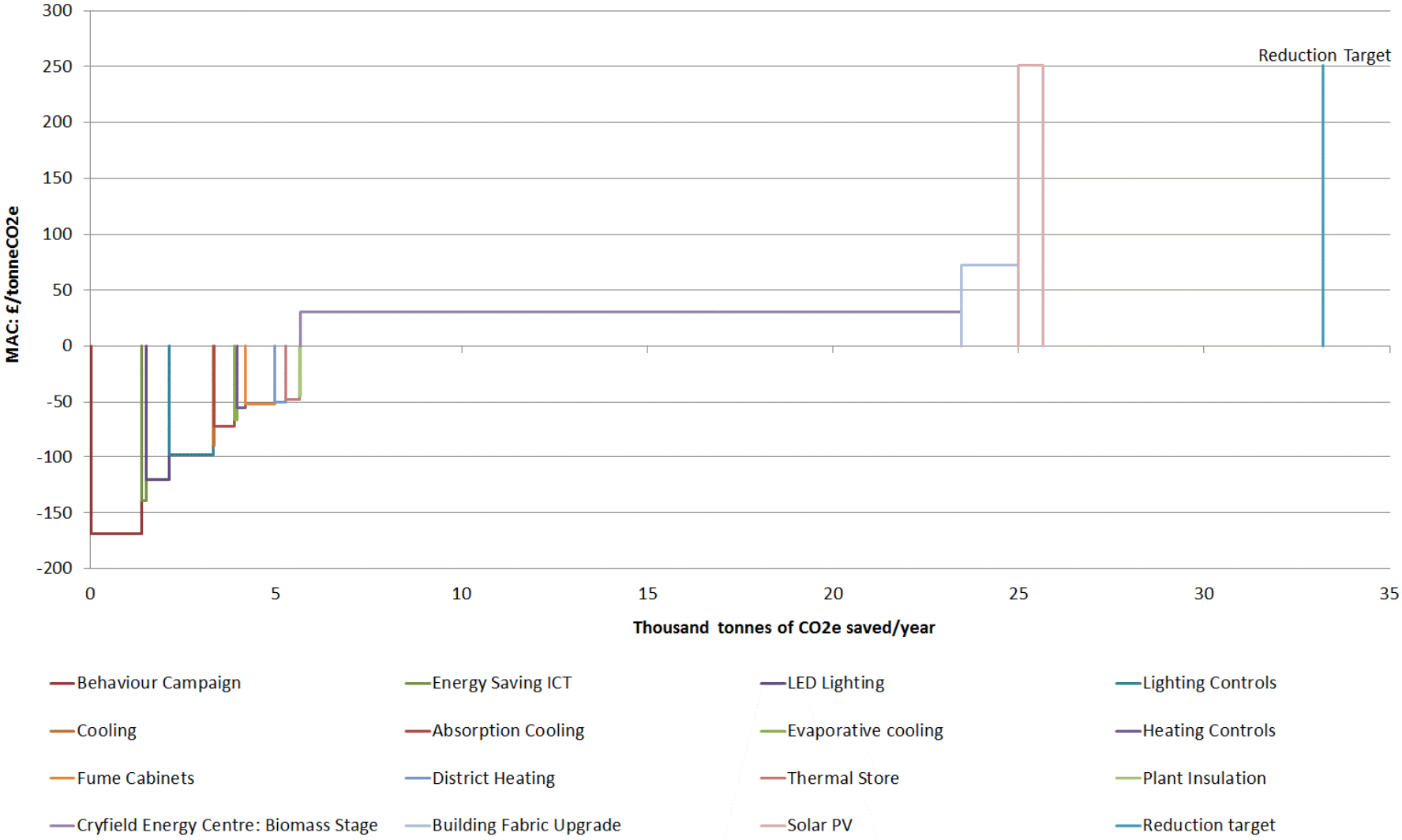
A suite of potential carbon reduction projects have initially been identified. It should be stressed that the list of projects underpinning this implementation plan is not exhaustive, with all projects subject to ongoing refinement and assessment to ensure their continued appropriateness from economic, social and/or environmental perspectives.

A significant carbon reduction project. The conversion of the University's combined heat and power plant to run on low carbon fuel is at risk in the timescales of this plan. Biomass CHP technology has not matured at the rate previously predicted by the energy sector.

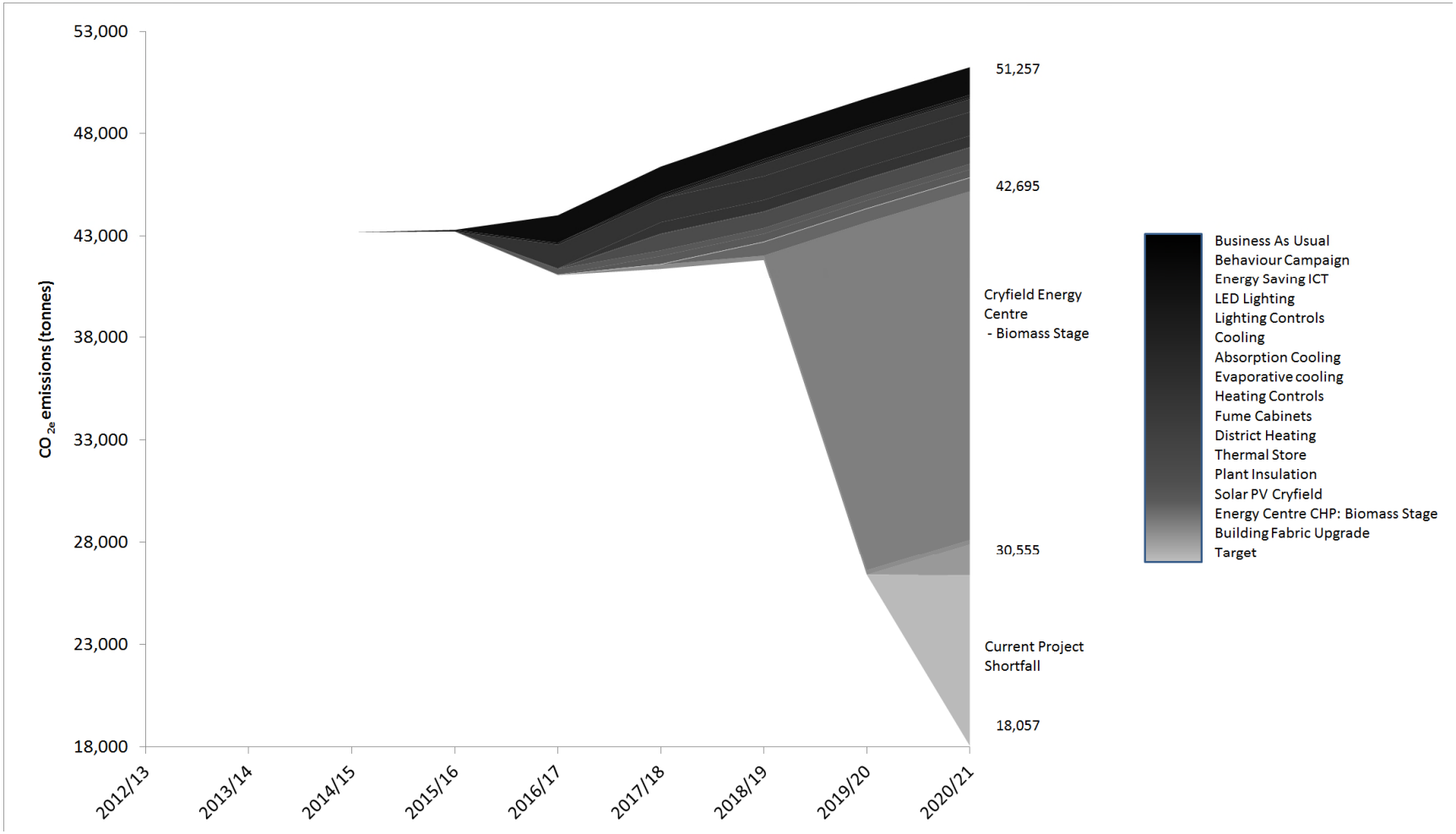
In total, carbon reduction projects totaling 29,303 tonnes CO_{2e} have been identified compared to the savings of 33,200 tonnes CO_{2e} required to achieve the carbon reduction target. This means that, through the projects detailed in this plan, over 70% of the required emissions' reduction has been identified. In addition, over 80 projects have been identified but the potential savings have not yet been quantified.

A summary of the project themes is given in the following graph:

The following Marginal Abatement Cost (MAC) graph illustrates the MAC cost/carbon effectiveness (£/tonne CO_{2e}) against the annual carbon savings (thousands tonnes CO_{2e} per year). The cost uses 6% NPV rate so the projects which have a negative MAC are net NPV saving while those above the line have a net NPV cost and this will be considered when prioritising project implementation.



The information in the MAC curve above is shown in a time series format which indicates the savings may be achieved from implementing the projects above prioritized according to ascending marginal abatement cost.



The following table presents the projects which have a negative MAC. They represent projects which we propose for implementation:

Project Type	Project cost (£)	Annual savings (£)	Annual CO_{2e} saving (tonnes)	No. Projects	Payback period (years)	MAC (£/tonne)
Behaviour Campaign	£100,000	£293,342	1353	1	0.3	-168.54
Energy Saving ICT	£29,900	£27,399	126	1	1.1	-139.01
Evaporative cooling	£58,691	£18,016	83	2	3.3	-66.95
LED Lighting	£245,000	£136,313	629	1	1.8	-120.23
Lighting Controls	£680,167	£252,068	1163	14	2.7	-98.24
Absorption Cooling	£544,408	£118,038	558	5	4.6	-72.77
Cooling	£5,000	£5,740	26	1	0.9	-89.37
Heating Controls	£106,842	£34,129	218	8	3.1	-54.90
Fume Cabinets	£500,000	£123,497	791	1	4.0	-51.73
District Heating	£343,422	£54,780	279	2	6.3	-50.59
Thermal Store	£320,000	£60,375	386	3	5.3	-47.67
Plant Insulation	£15,125	£3,845	25	1	3.9	-36.39
Total	**£11,422,412**	**£2,312,757**	**9818**	**42**		

The following table presents the projects which have a positive MAC. These projects include those with significant carbon benefits:

Project Type	Project cost (£)	Annual savings (£)	Annual CO_{2e} saving (tonnes)	No. Projects	Payback period (years)	MAC (£/tonne)
Cryfield Energy Centre CHP: Biomass Stage	£14,000,000	£610,578	17792	1	22.9	30.24
Solar PV	£5,191,542	£201,406	655	2	25.8	251.43
Building Fabric Upgrade	£8,097,572	£240,750	1541	5	33.6	242.63
Total	**£27,289,114**	**£1,052,734**	**19,988**	**8**		

* The total saving has been reduced to avoid double counting with the Cryfield Energy Centre CHP: Gas Stage.

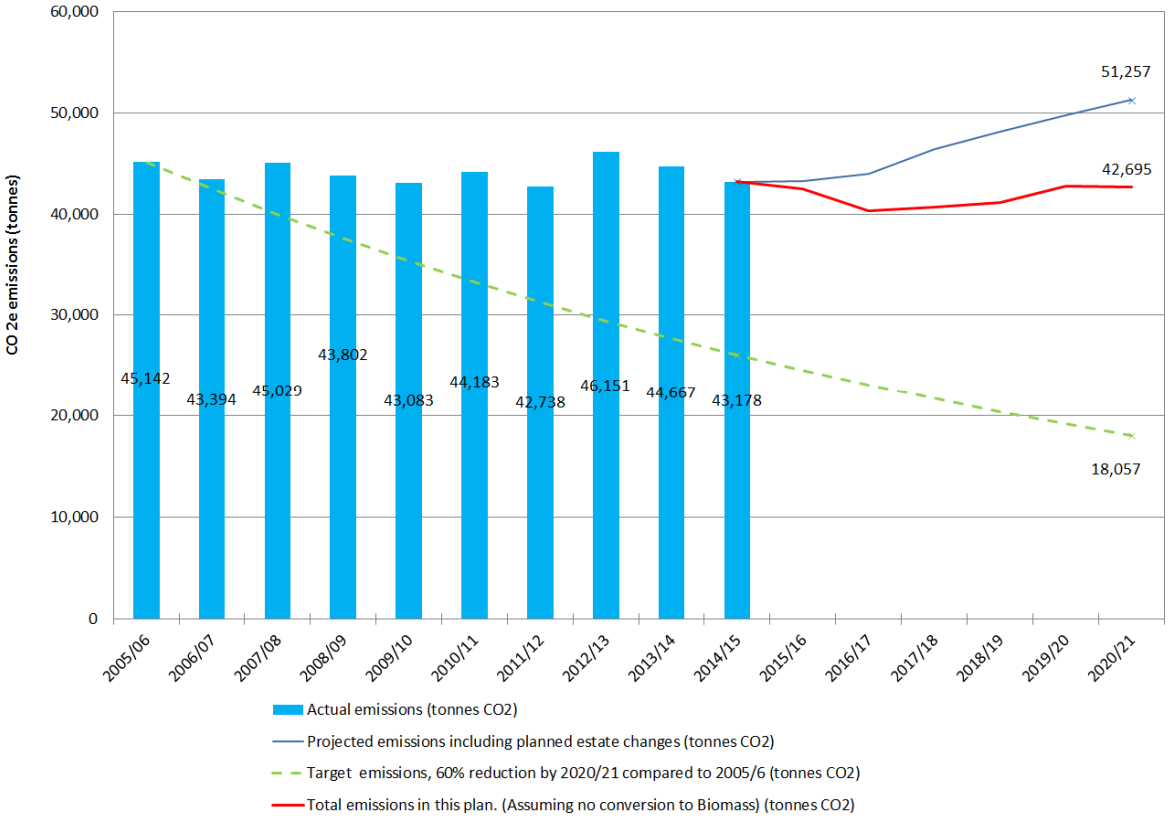
All projects with a positive NPV financial evaluation are submitted to the University financial process. The exact phasing of the proposed projects will be subject to business case and funding approval. Projects which do not demonstrate financial viability will be further investigated. Additional potential projects will be added to match the University commitment for carbon reduction.

The graph showing the year by year predicted achievement of the carbon reduction target will be completed once dates for project completion have been established.

Appendix 3 contains a list of projects which have been completed as part of the carbon reduction programme.

3.2 Key Projects

The future conversion of the Cryfield Energy Centre to a low carbon fuel source has been modeled and is included in the plan as a potential project. As discussed previously this project is at risk in the timescales of this plan. Biomass CHP technology has not matured at the rate previously predicted by the energy sector. Using biomass as a fuel source for the energy centre could provide an annual CO_2 saving of 17,792 tonnes (equating to approximately 50% of the total target savings). The effect of not converting the Cryfield Energy Centre to a low carbon fuel source on the University's projected Carbon emissions is shown in the chart below. The Universities Carbon emissions may only be reduced to 42,695 tonnes per annum based on currently identified projects. This equates to a 5% reduction in emissions from the 2005/06 baseline



3.3 Risk register

A risk register (Excel file) is being produced to cover the following risks:

- Changing carbon taxation levels - including EU ETS, CRC EES, CCL
- Changing carbon subsidy levels - including ROCs, FITs, RHI
- Change in emissions due to a change in the University operation such as new buildings, new equipment
- Changes in other legislative requirements impacting on carbon reduction projects e.g. Part L, air quality (combustion biomass) etc.

- Changes in emissions factors - for supply of grid electricity but may also affect other sources of emissions. Will reduce rate at which electricity saving projects save carbon emissions, but overall carbon footprint will also be reduced
- Changes to electricity transmission charges
- Energy cost increases/volatility
- Equipment failure leading to reduced amounts of low carbon energy being generated on site
- Weather - extreme weather conditions leading to variability in the amount of energy consumed on site
- Calculation of NPVs

3.4 Carbon reduction financing

As part of the annual financial planning process a request for resources have been submitted:

- Financial revenue resources to deliver small scale projects and further feasibility studies.
- Financial capital resources to deliver the projects identified in the "negative MAC" chart.
- Human resources to enable the deployment of the behaviour change program.

3.5 Embedding carbon management

a) In order to embed carbon efficiency in the day to day operation the University is committed to:

- Implementing a reporting tool enabling each department / building to gain visibility of their carbon intensity. The tool will also support an incentive mechanism to reward good behavior and successful saving projects.
- Deploy a comprehensive communication plan to maintain a "background" of carbon and energy efficiency awareness amongst all stakeholders. The continuous communication and engagement with all stakeholders (students, staff, and academia) will support each individual to change their behaviour while developing a positive message of "I feel comfortable to adopt the Warwick way".
- Embed low carbon design and technologies in all new buildings and major refurbishments. The University strategy is to deliver BREEAM Excellent and EPC A new build (energy performance certificate rating A).

b) Plans and proposal for improvement:

- Work is taking place between the Carbon Challenge Group and the University's research communities to identify how and where the University campus can become a test bed for innovations. The Carbon Challenge Group will support the activities of the University GPP (Global Priority Programmes) and in particular the GPP Energy.
- Through the Carbon Challenge Group students and academics associate to develop ways in which sustainability skills can be further embedded in the curriculum.
- Work is in progress to improve the sustainability of the University IT infrastructure.

4. Appendix

Appendix 1. Historical Emissions by Fuel Type.

2006-07	Source	Total	Emission Factor	Carbon Emission (tonnes)
Scope 1	Oil	422,912 kWh	0.25972	110
	Gas	144,644,927 kWh	0.185	26,759
	Fleet	137,906 litres	2.6391	364
Scope 2	Grid Electricity	32,652,083 kWh	0.4949	16,161
			Total 2006-07	**43,394**

2007-08	Source	Total	Emission Factor	Carbon Emission (tonnes)
Scope 1	Oil	599,705 kWh	0.24683	148
	Gas	141,179,132 kWh	0.185	26,118
	Fleet	146,064 litres	2.672	390
Scope 2	Grid Electricity	37,550,608 kWh	0.48956	18,383
			Total 2007-08	**45,029**

2008-09	Source	Total	Emission Factor	Carbon Emission (tonnes)
Scope 1	Oil	73,585 kWh	0.25421	19
	Gas	144,601,093 kWh	0.18523	26,784
	Fleet	163,341 litres	2.672	436
Scope 2	Grid Electricity	35,648,385 kWh	0.46868	16,708
			Total 2008-09	**43,802**

2009-10	Source	Total	Emission Factor	Carbon Emission (tonnes)
Scope 1	Oil	63,600 kWh	0.28164	18
	Gas	146,548,007 kWh	0.184405	27,024
	Fleet (Diesel)	160,423 litres	2.6413	424
	Fleet (Petrol)	844 litres	2.3117	2
Scope 2	Grid Electricity	34,242,221	0.456035	15,616
			Total 2009-10	43,083

2010-11	Source	Total	Emission Factor	Carbon Emission (tonnes)
Scope 1	Oil	54,795 kWh	0.24681	14
	Gas	136,728,093 kWh	0.1852	25,323
	Fleet (Diesel)	128,261 litres	2.6676	342
	Fleet (Petrol)	2,101 litres	2.3117	5
Scope 2	Grid Electricity	40,858,676 kWh	0.4528	18,499
			Total 2010-11	**44,183**

2011-12	Source	Total (kWh)	Emission Factor	Carbon Emission (tonnes)
Scope 1	Oil	52,572 kWh	0.24681	13
	Gas	135,728,360 kWh	0.18521	25,138
	Fleet (Diesel)	87,370 litres	2.5725	225
	Fleet (Petrol)	1,790 litres	2.3117	4
Scope 2	Grid Electricity	38,338,964 kWh	0.4528	17,358
			Total 2011-12	42,738

2012-13	Source	Total (kWh unless stated)	Emission Factor	Carbon Emission (tonnes)
Scope 1	Oil	60,435	0.2459	15
	Gas	164,545,475	0.1846	30,379
	Fleet (Diesel)	81,009 litres	2.5725	210
	Fleet (Petrol)	1,790 litres	2.3117	4
Scope 2	Grid Electricity	34,329,805	0.4528	15,543
			Total 2012-13	46,151

2013-14	Source	Total (kWh unless stated)	Emission Factor	Carbon Emission (tonnes)
Scope 1	Oil	51,804	0.2461	13
	Gas	146,950,726	0.1845	27,113
	Fleet (Diesel)	102,026 litres	2.6016	265
	Fleet (Petrol)	2,135 litres	2.2029	5
Scope 2	Grid Electricity	36,755,921	0.4699	17,271
			Total 2013-14	44,667

2014-15	Source	Total (kWh unless stated)	Emission Factor	Carbon Emission (tonnes)
Scope 1	Oil	24,466	0.2466	6
	Gas	164,097,830	0.1847	30,311
	Fleet (Diesel)	98,219 litres	2.5932	255
	Fleet (Petrol)	2,269 litres	2.1929	5
Scope 2	Grid Electricity	26,351,394	0.4782	12,602
			Total 2014-15	43,178

Appendix 2. – Summary of emissions and cost projections

Year	Projected annual emissions accounting for estate changes (tonnes CO_{2e})	Target annual emissions (tonnes CO_{2e})	Emissions savings (tonnes CO_{2e})	Projected annual energy cost accounting for planned estate changes (incl. fuel inflation) (£)	Target annual energy cost from current year (£) (incl. fuel inflation)	Energy cost with projects identified (£) (incl. fuel inflation)
2014/15	43,178	26,051	18,793	8,417,006	8,417,006	8,417,006
2015/16	43,300	24,507	20,954	8,109,632	7,516,059	8,091,616
2016/17	44,009	23,055	24,705	8,156,007	6,711,548	7,528,216
2017/18	46,393	21,689	27,710	7,793,112	5,993,152	6,919,921
2018/19	48,113	20,403	30,550	8,148,745	5,351,651	6,937,835
2019/20	49,744	19,194	33,200	8,856,989	4,778,816	7,035,501
2020/21	51,257	18,057	18,793	9,563,984	4,267,297	7,501,747
Total	325,994	152,956	173,038	59,045,475	43,035,530	52,431,842

Appendix 3. – Completed Projects.

Projects completed as part of the carbon reduction programme.

Location	Project Description	Project Type	Completion Date	Project cost (£)	Estimated annual saving (£)	Estimated Payback period (years)	Estimated annual saving (tonnes CO_{2e})
Rootes Social and Benefactors	Connect District Heating	District Heating	01/12/2015	815	£470.40	4.96	388
Warwick Medical School	Convert fume cabinet to VAV	Fume Cabinets	30/10/2014	365000	£73,651.00	3.29	13.6
Milburn House	Micro CHP	CHP	20/03/2014	7500	£2,280.00	6.86	13.31
Computer Science	Modify Ventilation Plant to Demand Control	Ventilation	29/07/2013	£8,992.89	£2,325.01	3.87	11.33
Campus Wide	Thermal Insulation to Heating Plant	Insulation	03/06/2013	£4,786.55	£2,129	2.25	13.63
Zeeman	Server Room evaporative cooling unit	Evaporative cooling	08/04/2013	£44,622.57	£8714.30	5.12	40.19
East Site Energy Centre	East Site CHP Replacement	CHP	15/06/2013	£313,330	£34,829	9.00	199.6
Campus Wide	Demand Control Ventilation	Ventilation Upgrades	21/02/2013	£120,367	£19,159	6.28	134.8
Heronbank	LED Lighting in Corridors with improved controls.	LED Lighting	10/12/2012	£122,645	£15,067	8.14	89.91
Chemistry	Draught proofing: 4th Floor	Building Fabric Upgrade	31/10/2012	£3,687.15	£2,496	1.48	19.98
Conference Centres	Lighting Controls in all Public Areas Radcliffe, Scarman.	Lighting Controls	26/10/2012	£12,941.00	£1,463	8.85	9.79
Westwood Games Hall	PIR Sensors in 11 Locations.	Lighting Controls	18/10/2012	£4,375.00	£2,075	2.11	13.89
Car Park 8 and 12	Update to LED Lighting throughout and add Controls	Lighting Controls / LED	10/09/2012	£44,821.00	£8,775	5.11	58.74

Location	Project Description	Project Type	Completion Date	Project cost (£)	Estimated annual saving (£)	Estimated Payback period (years)	Estimated annual saving (tonnes CO_{2e})
Radcliffe House	LED Lighting in Dining Area with improved controls.	LED Lighting	31/08/2012	£45,626	£9,046	5.04	41.72
Library	Draught proofing: 4th Floor	Building Fabric Upgrade	31/08/2012	£9,596.43	£1,408	6.82	11.27
Car Park 1A and 15	Update to LED Lighting throughout and add Controls	Lighting Controls / LED Lighting	01/08/2012	£68,736.00	£10,308	6.67	69.00
Library	Draught proofing: 5th Floor and Staff Offices	Building Fabric Upgrade	01/08/2012	£11,524.48	£1,408	8.19	11.27
Costcutter Supermarket	LED Lighting	LED Lighting	20/07/2012	£14,088.00	£2,899	4.86	19.41
Science C Block	Change time setting to cancel 24/7 heating. Implement set back overnight + week end. Saving may not be 218913 but less depending of the acceptable set back + slope	Heating Controls	01/07/2012	£1,000.00	£5,022	0.20	40.19
Biotechnology	Steam Trap Replacement	Heating Upgrades	12/05/2012	£2,631.11	£2,235	1.18	17.6
Car Park 7	Update to LED Lighting throughout and add Controls	Lighting Controls / LED Lighting	20/03/2012	£77,309.00	£11,975	6.46	80.16
Argent Court Data Centre	Cooling - upgrade cooling system from baseline proposal. Included in Major Projects	Dry Air Cooling	15/03/2012	£280,565.00	£57,879	4.85	387.45
Radcliffe House / Argent Court / Arden House	PIR Sensors in 80 Locations	Lighting Controls	20/02/2012	£8,221.40	£2,370	3.47	15.87
Science B Block	Upgrade 8 Fume Cabinets in Lab B133 to VAV control	Variable Speed Drives	01/02/2012	£24,952.81	£6,885	3.62	53.46

Location	Project Description	Project Type	Completion Date	Project cost (£)	Estimated annual saving (£)	Estimated Payback period (years)	Estimated annual saving (tonnes CO_{2e})
Sports Centre	Control Swimming Pool Pumps with Variable Speed Drives. Reduce flow rate overnight and during vacations	Variable Speed Drives	01/12/2011	£6,815.42	£3,473	1.96	23.25
Rootes J-L	Additional PIR Controls to be included as part of ECG Rootes J-L rewire project	Lighting Controls	30/09/2011	£3,780.00	£774	4.88	5.18
Rootes Residences A-C D-H	District heating connection to off load standalone boilers	District Heating	30/09/2011	£219,535.08	£41,790	5.25	334.46
Biotechnology	Replace oversize "bottle wash" boiler with smaller	Boiler Replacement	15/09/2011	£16,226.00	£1,432	11.33	11.46
Rootes J-L	Replace External Floodlighting	LED Lighting	22/08/2011	£2,982.00	£320	9.31	2.14
Lakeside	Daylight and PIR Sensors to existing 24 hour Lighting in Lakeside 5 Stairwells	Lighting Controls	22/08/2011	£5,900.00	£1,181	5.00	7.90
Scarman House	ECG Project to replace Halogen with LED in Hospitality Areas	LED Lighting	15/08/2011	£27,130.00	£4,362	6.22	29.20
Bio Sciences	Contribute to Low Energy freezer	Freezers	14/07/2011	£2,975.00	£844	3.53	5.65
EAT Restaurant	New front of house Lighting	LED Lighting	12/07/2011	£20,856.00	£3,985	5.22	26.68
Medical School	Fit remote mechanical actuators to inaccessible radiator TRV's	Heating Controls	30/06/2011	-	£0	-	0.00
Scarman House	PIR Sensors in 5 Locations	Lighting Controls	31/05/2011	£925.00	£198	4.67	1.33

Location	Project Description	Project Type	Completion Date	Project cost (£)	Estimated annual saving (£)	Estimated Payback period (years)	Estimated annual saving (tonnes CO_{2e})
Campus Wide	LED Installation List up to 18/05/2011	LED Lighting	19/05/2011	£267,138.00	£49,153	5.43	329.04
University House	University House data centre (SEELS) Implement 4 evaporative cooling units allowing the electrical chiller to be stopped most of the year	Evaporative cooling	20/04/2011	£42,333.00	£29,470	1.44	197.28
IT services	IT services coms room (SEELS) Implement 1off evaporative cooling unit allowing the electrical chiller to be stopped most of the year (including building alteration)	Evaporative cooling	20/04/2011	£10,673.00	£7,887	1.35	52.80
Physical Sciences	IT services coms room physical sciences Implement 1off evaporative cooling unit allowing the electrical chiller to be stopped most of the year (including building alteration)	Evaporative cooling	20/04/2011	£14,143.00	£14,735	0.96	98.64
F Block Engineering	F Block coms room physical sciences Implement 1off evaporative cooling unit allowing the electrical chiller to be stopped most of the year (including building alteration)	Evaporative cooling	20/04/2011	£15,725.00	£14,735	1.07	98.64
Westwood Old Library	Implement 1off evaporative cooling unit allowing the electrical chiller to be stopped most of the year (including building alteration)	Evaporative cooling	20/04/2011	£14,584.00	£6,549	2.23	43.84
University House	University House UPS room (SEELS) Implement 1off evaporative cooling unit allowing the electrical chiller to be stopped most of the year (including building alteration)	Evaporative cooling	20/04/2011	£13,785.00	£7,887	1.75	52.80
Rootes Social Building	300 Halogen Lights Replaced with LED	LED Lighting	15/03/2011	£9,000.00	£5,399	1.67	36.14
IMC	CO2 + VSD to Control 200 Seat Lecture Hall Ventilation System	Variable Speed Drives	10/03/2011	£4,909.00	£1,713	2.87	11.47

Location	Project Description	Project Type	Completion Date	Project cost (£)	Estimated annual saving (£)	Estimated Payback period (years)	Estimated annual saving (tonnes CO_{2e})
Bio Sciences	Contribute to Low Energy freezer	Freezers	10/03/2011	£1,250.00	£249	5.02	1.67
Student Union	Dichroic and SA111 Lighting Refit throughout	LED Lighting	28/02/2011	£6,720.00	£3,369	1.99	22.55
EAT Restaurant	Connect EAT Restaurant to District Heating	District Heating	27/01/2011	£103,450.55	£36,499	2.83	292.12
Westwood Residences	Boiler burner firing management system	Heating Controls	12/01/2011	£6,490.72	£1,734	3.74	13.88
Campus Wide	Reduce non-residential temperature by 1degC on BMS. Assume saving is 7% per degree as per benchmark documentation total heat used on campus is 87,000 MWh per annum	Heating Controls	15/12/2010	£3,000.00	£139,705	0.02	1118.12
Radcliffe and Scarman	Use VSD to Control Kitchen Ventilation flow Rate Based on Demand	Variable Speed Drives	10/12/2010	£23,625.73	£11,051	2.14	73.98
Social Studies	Replace 50 watts dichroics by LED	LED Lighting	22/10/2010	£2,600.00	£1,525	1.71	10.21
Rootes Social Building	Use VSD to Control Kitchen Ventilation flow Rate Based on Demand	Variable Speed Drives	08/09/2010	£9,999.00	£8,441	1.18	56.51
Student Union	Connect Student Union South to District Heating	District Heating	06/09/2010	£102,934.11	£12,353	8.33	98.87
Computer Science	District cooling - Maths to Computer Sciences Upgrade mains + pump to 100mm dia.	Absorption Cooling	31/08/2010	£54,340.04	£21,160	2.57	141.65
University House	Solar film across 53 bays, on 256 windows kWh and financial savings estimated	Solar Control	31/07/2010	£13,954.30	£2,799	4.99	18.73
Campus Wide	Replace 20 Physical Servers with 2 Virtual Host Servers	Energy Saving ICT	31/07/2010	£257,000.00	£75,517	3.40	505.52

Location	Project Description	Project Type	Completion Date	Project cost (£)	Estimated annual saving (£)	Estimated Payback period (years)	Estimated annual saving (tonnes CO_{2e})
Library	New TRV's and Temperature Controls	Heating Controls	29/07/2010	£25,614.00	£6,882	3.72	55.08
IMC	Use variable speed drive control to regulate air compressors	Variable Speed Drives	16/06/2010	£10,318.00	£2,280	4.53	15.26
Heronbank	Connect Heronbanks to District Heating	District Heating	08/06/2010	£22,982.00	£24,399	0.94	195.28
Sports Centre	Connect Sports Centre to District Heating	District Heating	01/06/2010	£54,193.67	£19,758	2.74	158.13
Campus Wide	Loft Insulation: Tocil, Claycroft, Jack Martin, Cryfield, Scarman, Radcliffe, Arden/Felden, Westwood A-D, Social Studies, Institute of Education	Building Fabric Upgrade	31/10/2009	£100,516.76	£21,862	4.60	174.97
Centre for Lifelong Learning	Change T12 to T5 Fittings and add controls	Lighting Controls	01/07/2009	£5,267.00	£312	16.90	2.09
£2,188,486	**£722,141**	**-**	**5,265.4**				

Appendix 4. - Document Change Record 2013 -2014

2.1 Baseline and assumptions

- Emissions pertaining to transport and distribution of grid electricity removed from Scope 2 emissions calculations in line with HESA methodology. Baseline and historical data updated.
- New data added for emissions, Staff and Student FTE and Turnover 2014/15.
- Emissions in absolute terms, Emissions Per staff and student FTE and Emissions per £1000 turnover updated to include 2014/15 figures.

2.2 Emissions Projections

- 2020 Target reduced to 18,057 tonnes CO_2 after baseline figure (2005/6) updated according to 2013 DEFRA figures on historical grid electricity emissions.
- Emissions projections based on updated projects added to chart in section 1.3.

2.4 Value at Stake

Energy cost projections updated according to latest capital plan and Utilities 5 year plan.

3.1 Projects to reduce carbon emissions.

All carbon projects updated in Warwick toolkit spreadsheet and transferred to this document.