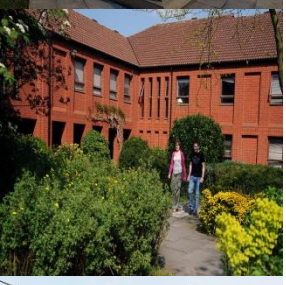


Brunel University London
Carbon Management Plan

David Bannister – Director of Estates
June 2015

Department of Estates
Chadwick Building
Brunel University London
Uxbridge
Middlesex
UB8 3PH

Carbon Management Plan

Date: ***FINAL DRAFT 27th MAY 2015***

Contents

Revision History

Revision	Version	Amendment	Date	Authorised
1	FINAL DRAFT	Revisions from EnSC and ISC	13th May 2015	David Bannister
2	FINAL DRAFT	Final Proof Read	27th May 2015	David Bannister

Foreword to 2015 Brunel Carbon Management Plan by VC

Executive Summary

The public now expects 'responsible' businesses and organisations to take action on climate change and is increasingly demanding action. Carbon reduction and a willingness to demonstrate good environmental performance has become a major marketing tool for universities.

This CMP replaces the 2010 Carbon Management Plan in its entirety and aims to demonstrate progress in Carbon emission reduction achieved since the first CMP. Brunel University London is a vibrant and forward-looking organisation driven by its 2012 five year strategic plan with its declared Vision *"To be a world-class creative community that is inspired to work, think and learn together to meet the challenges of the future."* Our target for Carbon emission reduction for 2020/21 has been revised to 43% from our base year of 2005/06 in line with HEFCE guidance. Carbon reduction projects would be co-ordinated with planned maintenance and Capital Funding but the cost would be additional to that funding.

A five year plan of projects, [Tranche 1] valued at circa £7 million has been developed to enable achievement of the carbon emissions reduction target delivering a reduction of 6000 tCO_2e. This plan assumes a zero increase in energy consumption. Tranche 2 projects will need to be developed to mitigate the effects of future new development.

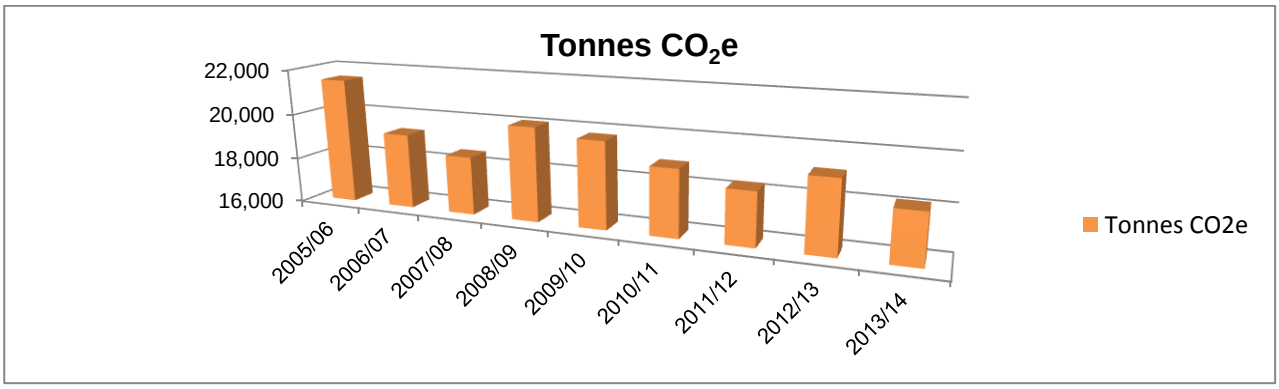
Future developments such as: the redevelopment of the Engineering Complex; New Sports Centre, Redevelopment of the Hamilton Centre; the construction of AMCC2 & 3; Learning and Teaching Centre and additional Residential Accommodation will require further Carbon reduction investment, and the key project [Tranche 2] will be the development of a new Energy Centre utilising combined heat and power technology, with an estimated cost of £11 million. The return on investment or payback of the Energy Centre is expected to be in the region of 12 to 15 years at current energy costs.

Table 1

Project	Cost £000's	Funding	Purpose
Tranche 1 Energy Saving Projects	7,100	Payback	List of projects [at Table 3] which would achieve intended carbon reduction by 2020/21. [Excludes the impact of future new development]
Tranche 2 Energy Saving Projects	11,000	Third Party /Payback	New Site Wide Energy Centre mitigating the expected increase in Carbon emissions from additional development 2015 to 2021.

Significant progress has been made in achieving Carbon emission reductions since 2010. 3,319 tonnesCO_2e have been saved through an investment of £6.5 million in Carbon reduction schemes, individual projects and behavioural change. This reduction can be seen in Table 2 with adjustments for cold weather in 2012/13 and new facilities: Isambard Complex, Michael Sterling and Eastern Gateway building:

Table 2



Proposed Carbon Reduction Projects [Tranche 1]

Table 3

Project Description		**Cost £**	**Carbon tCO_2e**	**Payback Years**
1	Review of Building Management System control settings	150,000	500	1
2	Fit insulation jackets to valves and flanges on services pipe work	100,000	100	2
3	Upgrade fan units on Air Handling Units (assume 10)	600,000	100	4
4	Improve zoning of heating systems	500,000	100	3
5	Install draught strips on doors and windows	200,000	25	4
6	Fit timers to water coolers, water boilers and general office type equipment (assume 200 items)	100,000	100	1
7	Presence detector control of lighting and plant in lecture theatres	500,000	100	4+
8	Presence and ambient light level control of lighting	650,000	200	5
9	Replace existing light fittings with high efficiency SMART type fittings	1,000,000	500	5+
10	Improve control of heating using programmable eTRV heads on radiators	600,000	300	4
11	Automatic Smart Meter Reading System	1,200,000	1,000	6
12	Use LED lighting with presence and ambient light level controls for common areas	500,000	200	5+
13	Install voltage reduction / stabilisation equipment	250,000	100	5
14	Energy and water conservation awareness campaign (5 Years)	10,000	1200	2
15	Institution-wide PC shutdown arrangements (5 Years)	100,000	250	2
16	Make turning all non-essential lights off at the end of building opening hour's as part of security/cleaning staff's duties	0	600	1
17	Improve facilities for cyclists by providing additional parking, showers etc.	100,000	Scope 3 Only	n/a
	Ongoing Rolling Green Fund Projects	540,000	608	5
	TOTAL	**£7,100,000**	**5,983 tCO_2e**	

Responsibilities for implementation of this plan are clearly defined ensuring its adoption across the University's community along with a robust communication strategy.

This Carbon Management Plan provides Brunel with a structured approach to Carbon management giving a clear statement of the main objectives and how it is intended that they will be met. The plan gives targets for emissions reductions which would also deliver significant financial benefits to Brunel and sets out a strategy by which those savings could be achieved.

1 Introduction

This Carbon Management Plan is to inform of progress to date and the direction required to meet the University's milestone and targets for carbon emission reductions from a base year of 2005/06.

Aspirational Target

Brunel University London will reduce its Scope 1 and 2 emissions against its 2005/06 baseline of 21,508 tCO_2e by 43% by 2020/21 to 12,260 tCO_2e. We will also seek to further assess and reduce our Scope 3 emissions.

Scope 1 Carbon Emissions are defined as direct emissions that occur from sources owned or controlled by the University.

Scope 2 Carbon Emissions are defined as emissions from the generation of purchased electricity consumed by the University.

Scope 3 Carbon Emissions are defined as emissions from:

- Water consumption
- Waste Water treatment
- Waste
- Travel – Business related plus daily commuting for Staff and Students
- Procurement related

The available Scope 3 data, excluding water, waste water and waste, are in their infancy and, therefore, do not indicate trends and prevent sufficient analysis for targets to be developed. However, it is anticipated that by 2015/16 that sufficient mature data will be accrued enabling relevant targets to be developed.

Progress to date

The table below indicates the Scope 1 (Gas) and Scope 2 (Electricity) emissions produced:

Scope 1 and 2 Carbon Emissions – tonnes CO_2e

Year	**2005/06**	**2006/07**	**2007/08**	**2008/09**	**2009/10**	**2010/11**	**2011/12**	**2012/13**	**2013/14**
Scope 1	10,569	8,503	7,149	7,912	7,822	7,528	7,088	7,957	6,682
Scope 2	10,939	10,772	11,398	12,183	11,947	11,378	11,221	11,174	11,507
Total	**21,508**	**19,275**	**18,547**	**20,094**	**19,768**	**18,907**	**18,310**	**19,131**	**18,189**

The figures show a decrease of 3,319 tCO_2e (15.4%) over the last eight years.

Scope 1 emissions have reduced overall by 37% through improvements to building design, insulation, heating control and changes in weather patterns. The potential for reducing Scope 1 emissions is limited to Building Management System improvements, local thermostatic radiator valve control and further improvements to building envelope insulation and is estimated to be no more than a further 15% by 2020/21.

Scope 2 emissions have increased overall by 5.2% since 2005/06 despite the implementation from 2010/11 of measures aimed at reducing electricity usage.

The institutional growth and resultant increase in electricity use means that the measures outlined in *Section 4* need currently to reduce carbon emissions overall by 5929 tCO_2e by 2020/21 at an estimated cost of £7million. An equal reduction is not feasible for both Scope1 and 2. For Scope 1 the measures outlined will produce an expected reduction of 1000 tCO_2e (15%) leaving 4929 tCO_2e to be achieved by Scope 2 reductions.

The ongoing and future development planned for the Campus includes replacement and additional facilities aimed at meeting the aspirational needs of Brunel. The projects and their impact are detailed in *3.9* and *4.5*. All of these projects will impact on the carbon reduction target and the reductions achieved by the planned and/or proposed measures outlined in *Section 4.*

Future progress

Key stakeholders have been identified including Responsible Persons to facilitate the full implementation of the Plan. A Communication Strategy is to be developed to ensure the whole Campus population is kept fully informed of progress.

The 2015 revision

In a national and international context, rising energy prices, increased concerns about security of energy supply and climate change are pushing the issue of carbon emissions up the political agenda. This combined with the need for Brunel University London to improve its environmental and financial sustainability and reduce its cost base makes it a good time for Brunel to review its strategy to manage its own emissions of carbon dioxide.

The public now expect 'responsible' businesses and organisations to take action on climate change and stakeholders are increasingly demanding action. It has become a major marketing strategy to demonstrate good environmental performance. Also, as energy costs continue to rise, it makes good business sense to reduce energy consumption. Policies, strategies and environmental management systems are being adopted accordingly.

Brunel is committed to reducing its environmental impacts and will reinvest part of the financial savings achieved via carbon management into further carbon reduction activities.

This Carbon Management Plan provides Brunel with a structured approach to carbon management giving a clear statement of the main objectives and how it is intended that they will be met. The plan gives targets for emissions reductions which would also deliver significant financial benefits to Brunel and sets out a strategy by which those savings could be achieved.

The overall goal is for Brunel University London to reduce its emissions.

This document is a revision of the 2010 Carbon Management Plan.

Factors informing this revision include:

- The experience gained in implementing the 2010 Carbon Management Plan
- The requirements of the Higher Education Funding Council for England (HEFCE), in particular:
    - Brunel has set a target of 43% reduction of Scope 1 and Scope 2 utility-related emissions by 2020/21 against a 2005/2006 baseline
    - Brunel is undergoing a base-lining exercise for Scope 3 indirect emissions (which covers those from water, waste, travel and procurement) in preparation for setting appropriate reduction targets

- HEFCE publication *2010/02 Carbon Management Strategies and Plans: a guide to good practice*.

A key development at Brunel since the 2010 Carbon Management Plan has been the adoption of Environmental and Energy Policies and this, the 2015 Carbon Management Plan implements key objectives of them both. It is recognised that communications, training and behavioural change are essential for the effective implementation of the Environment and Energy Policies and this Carbon Management Plan. A communications strategy is currently under development and will underpin the Environment and Energy Policies, this Carbon Management Plan and other implementation plans.

Progress on the implementation of the Carbon Management Plan and results from the projects listed under *Section 4* will be reported to the Infrastructure Strategy Committee via its Environment Sub-Committee. In addition progress will also be reported through the Energy page of the Estates web site and via other means identified in the communications plan (*Section 6)*.

About Brunel

It is situated in Uxbridge and was founded in 1966. Today it comprises of more than 9,800 undergraduates and over 4,000 postgraduates along with approximately 2500 staff.

The Brunel estate comprises of 40 Non-Residential Buildings and 37 Residential Buildings plus assorted ancillary buildings having a total gross internal area of 233,851m^2 with a physical estate exceeding 200 acres over 5 sites.

The utility budget including electricity, gas and water, for the entire Brunel estate, exceeded £4,500,000 for 2013/14.

2 Carbon Management

2.1 Context and drivers

A wide range of UK strategies, programmes, legislation, regulation and guidance now exist that encourage all sectors of society to reduce carbon emissions. The public now expect 'responsible' businesses and organisations to take action on climate change and stakeholders are increasingly demanding action. Also, as energy costs are expected to rise by 100% over the next decade it makes good business sense to reduce energy consumption. Policies, strategies and environmental management systems are being adopted accordingly.

It must be stressed that carbon management is not only an environmental activity, but one that, under this plan, will yield substantial financial savings.

Carbon management is best effected by reducing our consumption of electricity and fossil fuels. This has a welcome side effect for Brunel. As North Sea oil and gas resources become depleted we have become increasingly dependent on the world oil and gas markets, in which demand from emerging economies is increasing. Thus, reduction in our demand for fossil fuels, using what we need more efficiently and increasing our consumption from non-fossil sources are all good ways to insulate ourselves as a university and as part of the UK from higher fuel prices.

We believe that measures aimed at mitigating the potential for dangerous Climate Change are desirable in their own right, and Brunel can act as a leader for stakeholders, especially students, staff, alumni and colleague institutions, in delivering carbon emission reductions. We also understand that financial benefits will accrue from judicious action and that the organization will enjoy reputational benefits from being seen to act well and act early. The converse need hardly be stated: late, ineffectual action will be costly for Brunel and may damage its hard-won reputation.

Thus many drivers exist for the implementation of a carbon management programme, some of these being listed below:

- In the HEFCE publication *"Carbon Reduction Target and Strategy for Higher Education in England"*, a target is set for the sector to reduce Scope 1 and 2 emissions by 43% by 2020/21 against a 2005/06 baseline or 34% against a 1990 baseline. All higher education institutions are required to produce a Carbon Management Plan showing how it will contribute to achieving this target, failure to do so resulting in reduced funding from HEFCE

- The plan will reduce Brunel's financial liability to purchase emissions allowances under the Carbon Reduction Commitment (CRC)

- The EU Building Energy Performance Directive requires all public campus buildings to display a Display Energy Certificate giving visibility of carbon and energy performance to all building users. Data gathered as a result of this Carbon Management Plan will be very helpful in the ongoing production of these certificates and may reduce cost of their provision.

- Long term rises in utility costs would increase Brunel's operating costs and reduce funding for core university activities. Thus it is important to analyse opportunities for increased efficiency in the use of energy and water and also to ensure best methods of procurement are adopted.

- Compliance with building regulations Part L2 and F should give rise to improved efficiency in new buildings and existing buildings where major refurbishment takes place. However the requirement for increased ventilation rates for offices could potentially be a high energy overhead.

- Brunel should discharge its global social responsibility, in part by contributing to national targets to reduce greenhouse gas emissions.

- There are reputational and other competitive advantages to be gained from a pro-active approach to energy management and conversely a risk in lagging behind peers and competitors.

- The HEFCE sustainability strategy promotes sustainability in construction projects and refurbishments. Failure to comply may be reflected in reduced funding from HEFCE.

- Brunel offers courses that relate to climate change, environmental science and carbon management. Students may choose to select a university that can demonstrate an active institutional environmental management programme to support the teaching.

2.2 Low Carbon Vision

Vision Statement

Brunel will strive to enhance its environmental reputation by reducing its environmental impacts and make savings in its operational cost base through reducing the carbon footprint of the university by integrating the principles of carbon management into its corporate strategies and operational procedures.

The vision will be achieved through implementation of the measures outlined in this Carbon Management Plan.

We envisage a low-carbon environment in which:

- There is efficient energy generation and use

- There are innovative and energy efficient buildings, creating an environment in which it is easier for occupants to save energy and resources

- The environment is inspirational and an example to students and staff, and complements the educational and research environment

- Every employee is aware of their environmental responsibility and their role to reduce carbon emissions and is aware of the climate imperative and importance of actions to reduce Brunel's environmental impact

- Obvious improvements are made and more innovative flagship projects are examined further to improve environmental sustainability

- Brunel's reputation for environmental management matches its excellent reputation for academic performance

- Brunel is proud of its Campus and genuine achievements in institutional environmental management

- Creating the infrastructure and network of support for achieving the vision

2.3 Objectives and Strategy

This Carbon Management Plan is an updated and extrapolated version of the Carbon Management Plan adopted by Brunel in September 2010 which described a path for the reduction of emissions caused through energy use across the Campus.

This revised Carbon Management Plan has been produced to ensure:

- That there is a sonority of approach with the rest of Brunel's policy framework, particularly the Environmental and Energy Policies and the Estate Master Plan
- That energy, water and waste management overheads are kept at the lowest level consistent with Brunel's leading global research, teaching and learning activities and the pursuit of competitive advantage
- That we have a response to the requirements of HEFCE's Capital Investment Framework
- To promote carbon management issues to all members of the Brunel community and for carbon management to become standard university practice
- To facilitate new carbon reduction initiatives concentrating on energy consumption and to continue to review and improve wherever possible initiatives related to water conservation and waste minimisation
- That we are seen to fulfil our moral obligation to act on Climate Change
- That Brunel plays its part in achieving HEFCE's national sector targets
- Working with the student body to integrate principles of carbon management into the Union of Brunel Students portfolio of responsibilities
- That Brunel has a strategic tool to reduce its exposure to volatile energy markets and carbon trading schemes such as the European Union Emissions Trading Scheme and Carbon Reduction Commitment Energy Efficiency Scheme
- To develop further the application of life-cycle costing principles as they relate to capital estates and equipment projects
- That carbon is considered at the earliest planning stages of new buildings, refurbishment and procurement, when mitigation can be implemented most cost effectively
- That Brunel has a framework for considering Scope 3 emissions and their reduction now that they were included for the first time in the Estates Management Report submission for 2012/13.

3 Carbon Emissions

3.1 Scope 1 and 2

Scope 1 Carbon Emissions are described as direct emissions that occur from sources owned or controlled by the University.

Scope 2 Carbon Emissions are described as emissions from the generation of purchased electricity consumed by the University.

3.2 Baseline

Brunel's Scope 1 and 2 carbon emissions in 1990/91 are reported to be 17,591 tonnes CO_2e in the report to HEFCE by SQW "*Carbon baselines for individual Higher Education Institutions in England*" however we have calculated that our Scope 1 and 2 emissions in 2005/6 were 21,508 tonnes CO_2e utilising the accurate consumption data available. The basis for the preparation of the 1990/91 figure has been lost, so we have a much higher level of confidence in the 2005/06 figure, hence the choice for adopting 2005/06 as the baseline year.

3.3 Emissions since 2005/06

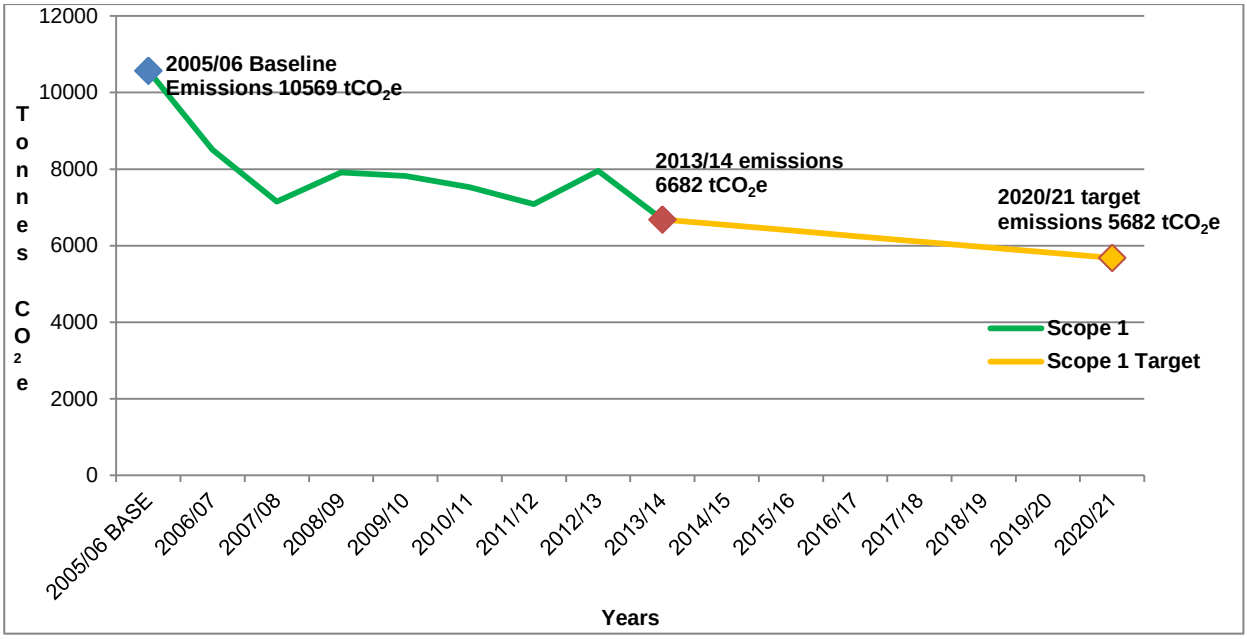
The table below indicates the Scope 1 (Gas) and Scope 2 (Electricity) emissions produced:

Scope 1 and 2 Carbon Emissions – tonnes CO_2e									
Year	**2005/06**	**2006/07**	**2007/08**	**2008/09**	**2009/10**	**2010/11**	**2011/12**	**2012/13**	**2013/14**
Scope 1	10,569	8,503	7,149	7,912	7,822	7,528	7,088	7,957	6,682
Scope 2	10,939	10,772	11,398	12,183	11,947	11,378	11,221	11,174	11,507
Total	**21,508**	**19,275**	**18,547**	**20,094**	**19,768**	**18,907**	**18,310**	**19,131**	**18,189**

The figures show a decrease of 3,319 tCO_2e (15.4%) over the last eight years.

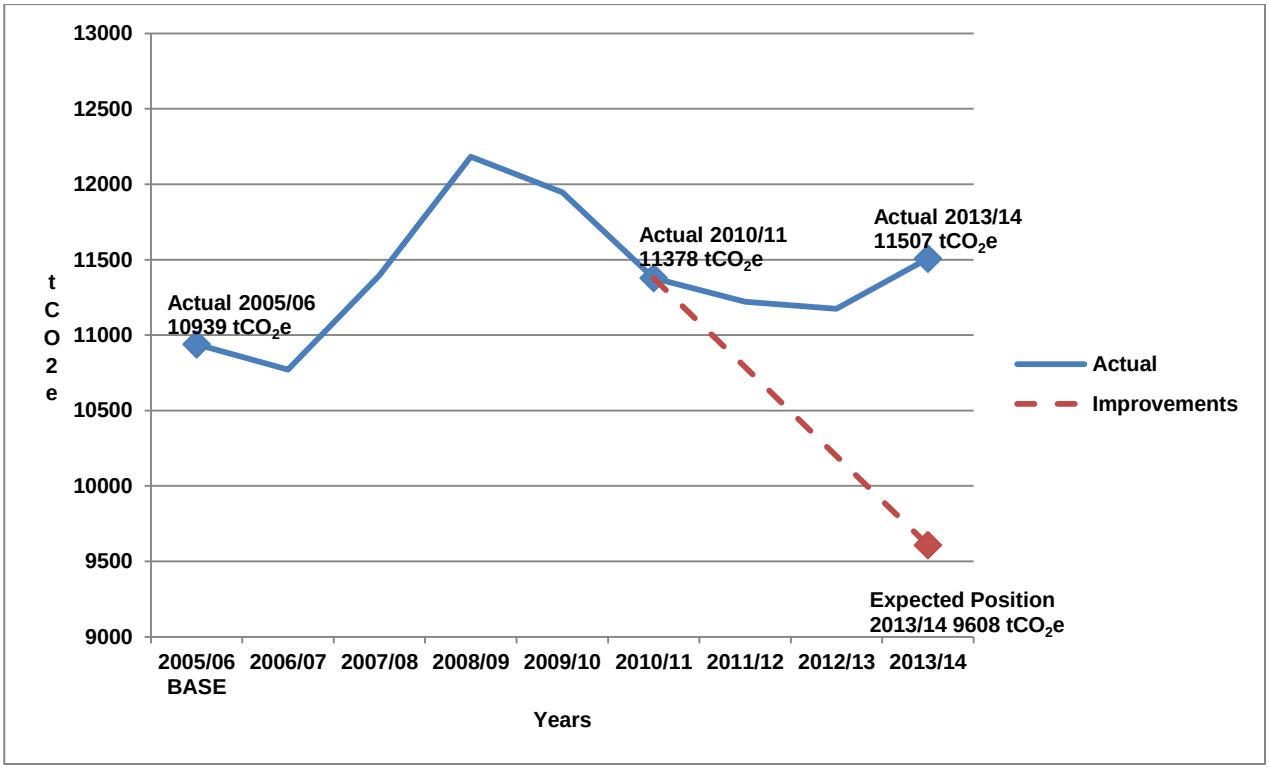
Scope 1 Emissions - Actual and Projected

Scope 1 emissions have reduced overall by 37% through improvements to building design, insulation, heating control and changes in weather patterns. The potential for reducing Scope 1 emissions is limited to Building Management System improvements, local thermostatic radiator valve control and further improvements to building envelope insulation and is estimated to be no more than a further 15% by 2020/21. This is demonstrated in the following graph:



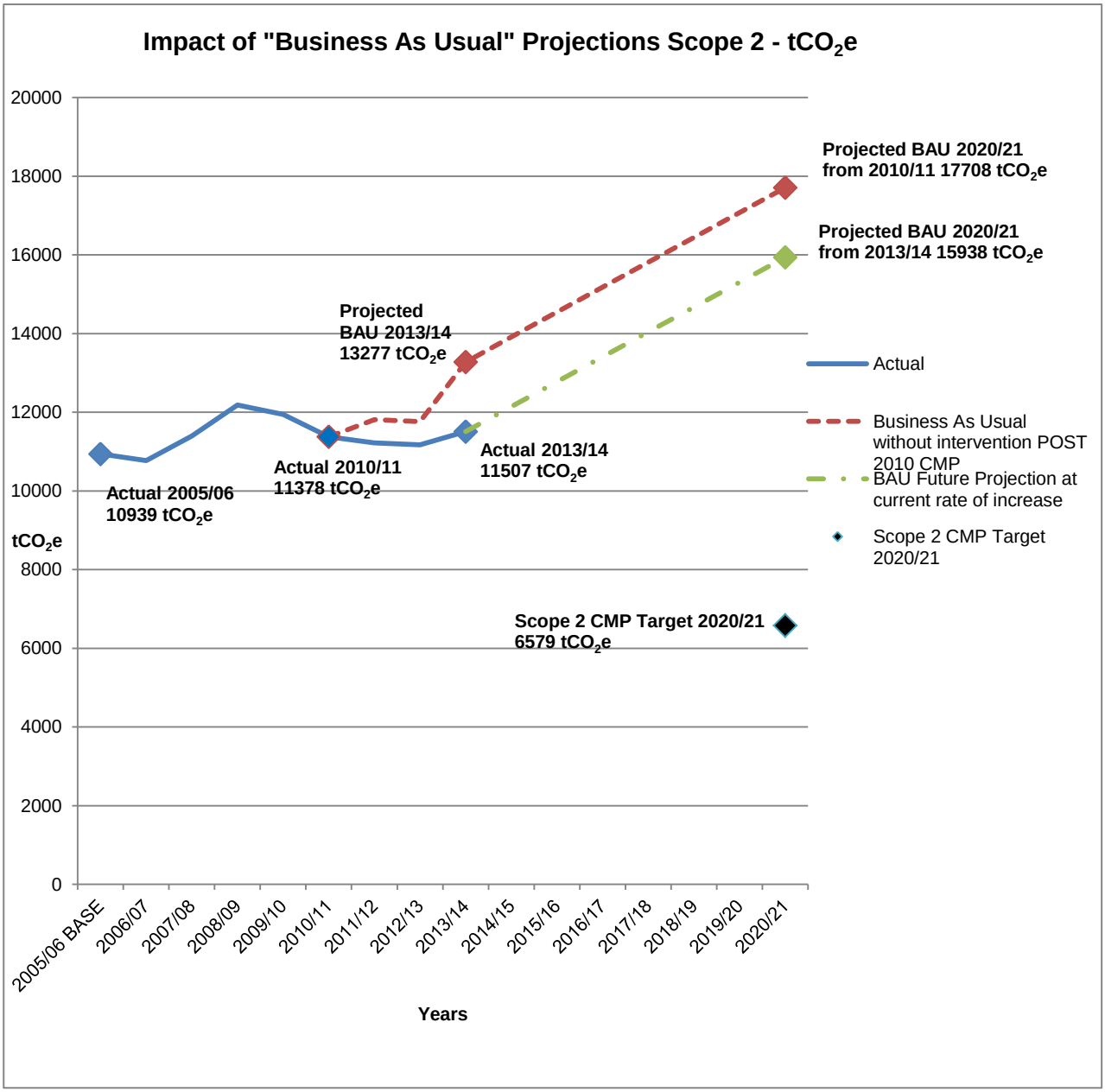
Scope 2 Emissions - Actual and Improvements

Scope 2 emissions have increased overall by 5.2% since 2005/06 despite the implementation from 2010/11 of measures aimed at reducing electricity usage. The increase is ascribable to the Eastern Gateway Building completion in 2011 and in the increased quantity and energy-intensity of the research now undertaken. This is shown in the following graph:



Scope 2 - Projected Business as Usual

To further illustrate the potential impact of failing to implement the improvements a state of "Business as Usual" (BAU) can be developed. In the following graph BAU is shown initially from 2010/11 to 2013/14 and then extended at the same rate to 2020/21 (in RED). BAU is also shown extended from 2013/14 actual to 2020/21 (in GREEN). These clearly demonstrate the failure of non-intervention in carbon emission reduction activities.

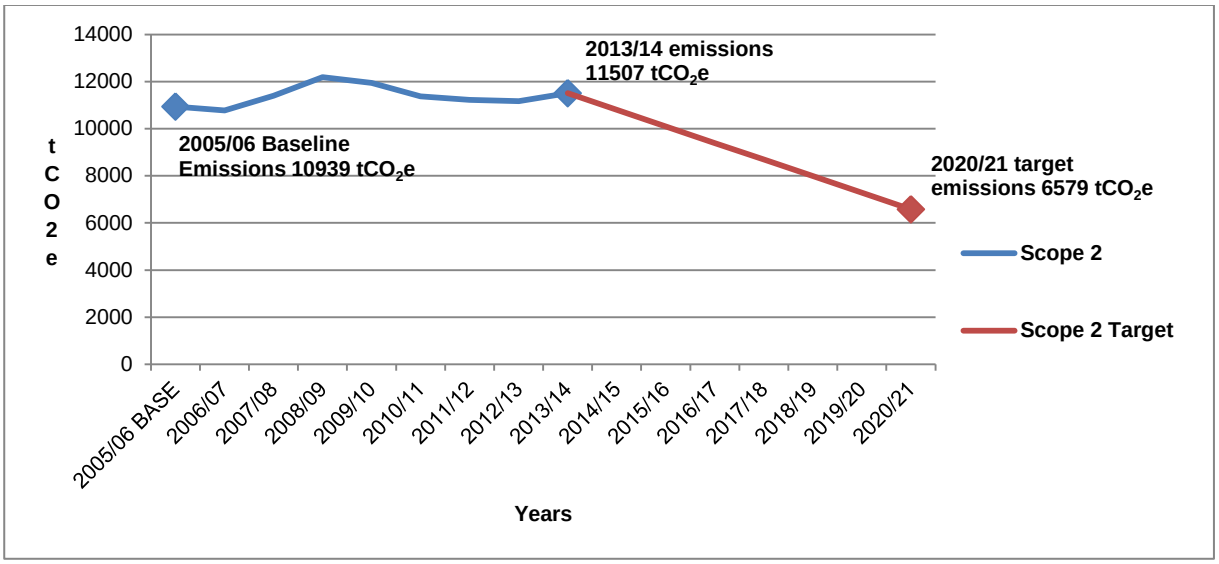


The increase we have seen is similar to that of some of our peer group; however, there are differences across the sector as a whole, with some institutions showing modest reductions. These differences are an indication of the wide spread of activities undertaken across the sector, and the differences between the buildings that support them.

Institutional growth and resultant increase in electricity use (5.2%) since 2005/6 means that the measures outlined in *Section 4* need currently to reduce carbon emissions overall by 5929 tCO_2e by 2020/21 at an estimated cost of £7million. Potentially this figure could be partially achieved by the implementation of a site wide Centralised Combined Heat and Power installation potentially in co-operation with another organisation. This project would have an estimated cost of £11million, provided by a third party, and potential saving of 4400 tCO_2e. This will all be in addition to those costs incorporated into planned major refurbishment and new build project budgets. An equal reduction is not feasible for both Scope1 and 2. For Scope 1 the measures outlined will produce an expected reduction of 1000 tCO_2e (15%) leaving 4929 tCO_2e to be achieved by Scope 2 reductions.

Scope 2 Emissions - Actual and Projected

Scope 2 actual emissions from 2005/06 to 2013/14 along with projected emissions are shown in the following graph:



3.4 Targets

Aspirational target

Brunel University London will reduce its Scope 1 and 2 emissions against its 2005/06 baseline of 21,508 tCO_2e by 43% by 2020/21 to 12,260 tCO_2e. We will also seek to further assess and reduce our Scope 3 emissions.

In order to meet the target reduction the current average growth of electricity consumption of 5.2% must be restricted to a maximum of 0% as from 2014/15. If growth were to continue, unchecked, at the same rate until 2020/21 our emissions would increase by 4431 tCO_2e.

In calculating progress towards this target on an annual basis, benchmarking will need to consider the following statistics for each year:

- Total building floor space in operation
- Number of full time equivalent staff
- Number of full time equivalent students
- Opening hours of buildings

- Number of external out of hours bookings

Changes in these statistics will need to be taken into account in the calculation of % change in CO_2e emissions and it is considered that growth in them is likely to result in a further increase in energy consumption and carbon emissions of between 3 and 5% per annum.

3.5 Past actions and achievements

Brunel has been very active in the field of utility conservation for a long time; all future work should build on and complement what has already been achieved.

The Estates Department has undertaken a range of work to improve energy and water efficiency and have looked at ways of increasing recycling rates and improving waste management. Energy and water efficiency work is undertaken in the interests of good financial best practice. The following list is not exhaustive but some of the past and ongoing work includes:

- Voltage Optimisation
- Lighting Replacement
- Mechanical Plant Replacement
- Window Replacement
- Hand Dryer Replacement
- Programmable eTRV Head Replacement
- Burner Management Control
- Switch Off Campaigns and Attitude / Behavioural Change
- Waterless Urinals
- Urinal flushing controls
- Building Energy Management System installation and improvements
- Integration of energy efficiency features in new buildings
- Maintenance of boilers and other plant to a high standard
- End of life HVAC equipment replaced with more energy efficient options
- Automatic (presence detection) and daylight dimming lighting controls
- Undertaken energy surveys on many buildings
- Investment in an energy Monitoring and Targeting system
- Phased installation of automatic meter reading equipment – Electricity, Gas & Water

These are estimated to have delivered combined savings in excess of 2,500 tonnes CO_2e with an approximate total investment to date of £6,500,000.

3.6 Scope 3

Scope 3 carbon emissions are defined as emissions from:

- Water consumption
- Waste Water treatment
- Waste
- Travel – Business related plus daily commuting for Staff and Students
- Procurement related

3.6.1 Water Consumption

Scope 3 emission for water used on the campus is intended to cover the energy used to treat and distribute water throughout the UK. It is a simple calculation of annual water usage in cubic meters multiplied by a conversion factor issued by Defra / DECC. The current conversion factor is 0.3441kgCO_2e/m^3.

The water consumption from 2005/06 to 2013/14 is shown in the following table:

Water Consumption - m^3									
	2005/06	**2006/07**	**2007/08**	**2008/09**	**2009/10**	**2010/11**	**2011/12**	**2012/13**	**2013/14**
Residential	208045	207182	164766	175142	238421	255060	271711	306676	308377
Estate	122710	127055	139810	132124	109887	117735	112985	106665	118502
Total	***330755***	***334237***	***304576***	***307266***	***348308***	***372795***	***384696***	***413341***	***426879***

Scope 3 emissions attributed to water consumption are shown in the following table:

Water Consumption - Scope 3 Emissions - tCO_2e									
	2005/06	**2006/07**	**2007/08**	**2008/09**	**2009/10**	**2010/11**	**2011/12**	**2012/13**	**2013/14**
tCO_2e	***91.3***	***92.3***	***84.6***	***92.2***	***118.4***	***126.8***	***130.8***	***142.2***	***146.9***

A Water Management Policy has been developed to establish procedures and recommended actions to enable Brunel to use conserve and discharge water as responsibly and sustainably as possible.

The policy of the University is to control water consumption in order to:

- Avoid unnecessary expenditure on water and drainage
- Improve cost-effectiveness
- Reduce our carbon emissions from water usage in line with national, sector-wide and institutional targets
- Protect the environment

In order to meet the above criteria, a number of objectives have been set:

- Target a reduction of water consumption and associated carbon emissions in line with the figures as set out in the University's Carbon Management Plan
- Utilise water from sustainable sources where practicable, including incorporation of renewable technologies into building development projects
- Invest in projects and equipment to reduce water usage across the University
- Raise awareness amongst staff and students of the important contribution each member can make to water conservation
- Ensure that commitment is obtained from staff at all levels within the University on aspects of water efficiency under their control, i.e., replacing "water to waste" cooling with closed loop cooling systems

The impact of climate change and rising demand for water are putting increasing pressure on our water resources. Water also uses electricity to treat, pump and heat it, so saving water can save energy thereby contributing to carbon management.

The parallel purpose of this policy is therefore to educate staff and students about all aspects of water i.e., consumption, waste and drainage, and raise awareness of how individuals can conserve water on campus through easily implementable actions as listed below:

- Don't leave tap running whilst cleaning your teeth or washing vegetables
- Take a shower – usually as they use 2 – 3 times less water than a bath
- Use a bowl in the sink and be aware of what can/cannot be emptied
- Keep bottles of water in the fridge for making cold drinks
- Report dripping taps as soon as possible

A variety of problems including underground leakages, estimated readings and a lack of water meters have resulted in inadequate data for monitoring and targeting purposes and accurate annual comparisons. This should be addressed by the Automated Metering Monitoring and Targeting system currently being installed across the University.

3.6.2 Waste Water Treatment

Scope 3 emissions cover the energy used in the collection, pumping, treatment and disposal of waste water and associated products throughout the UK. The calculation is identical to that for water in cubic meters multiplied by a conversion factor issued by Defra / DECC. The current conversion factor is 0.7085kgCO_2e/m^3. An assumption is made that a small % of the water supplied is not returned to the waste water system of 0.72%.

The waste water figures from 2005/06 to 2013/14 are shown in the following table:

Waste Water - m^3									
	2005/06	**2006/07**	**2007/08**	**2008/09**	**2009/10**	**2010/11**	**2011/12**	**2012/13**	**2013/14**
Residential	206547	205690	163580	173881	236704	253224	269755	304468	306157
Estate	121826	126410	138803	131173	109096	116887	112172	105897	117649
Total	***3328374***	***331830***	***302383***	***305054***	***345800***	***370111***	***381926***	***410365***	***423805***

Scope 3 emissions attributed to waste water are shown in the following table:

Waste Water - Scope 3 Emissions - tCO_2e									
	2005/06	**2006/07**	**2007/08**	**2008/09**	**2009/10**	**2010/11**	**2011/12**	**2012/13**	**2013/14**
tCO_2e	***227.6***	***230***	***209.6***	***228.8***	***242.1***	***259.1***	***267.4***	***290.7***	***300.3***

3.6.3 Waste

Scope 3 emissions for waste disposal can be calculated on the level of the waste stream analysis available.

- Basic – where only minimal information is available.
- Medium – where a breakdown between non-Residential and Residential waste is available.
- Detailed – where a full waste stream analysis and detailed quantified breakdown is available.

The level of waste data for Brunel is in the Medium area which allows for the available quantified breakdown to be further developed using, for non-Residential waste, *Waste Watch FHE Compositional Data (2005)* and for Residential waste, *Defra Municipal Waste Compositional Data (2008).* These data sets enable the quantified waste to be developed in to types of waste so that related carbon emissions can be calculated using conversion factors issued by Defra / DECC.

The waste figures from 2005/06 to 2013/14 are shown in the following table:

Waste - Tonnes									
	2005/06	**2006/07**	**2007/08**	**2008/09**	**2009/10**	**2010/11**	**2011/12**	**2012/13**	**2013/14**
Residential	176	205	819	1238	937	766	803	795	773
Estate	657	732	800	709	687	560	668	608	574
Total	***833***	***937***	***1619***	***1947***	***1624***	***1326***	***1471***	***1403***	**1347**

Scope 3 emissions attributed to waste are shown in the following table:

Waste - Scope 3 Emissions - tCO_2e									
	2005/06	**2006/07**	**2007/08**	**2008/09**	**2009/10**	**2010/11**	**2011/12**	**2012/13**	**2013/14**
tCO_2e	***231***	***237***	***471***	***574***	***162***	***279***	***314***	***28***	***27***

Note – method of HEFCE conversion and Defra conversion factors changed from 2012/13

3.6.4 Procurement Supply Chain Related

The Annual Returns Database (ARD) data covering all University procurement for the academic year is submitted to the sector Purchasing Consortia who, using bespoke software, produced a Scope 3 carbon emissions report. This was carried out for the first time for the year 2012/13. The results for the procurement categories for 2012/13 and 2013/14 are shown in the following table:

Procurement Categories	**2012/13 tCO_2e**	**2013/14 tCO_2e**
Business services	6,255	7,058
Paper products	661	574
Other manufactured products	2,761	2,914
Manufactured fuels, chemicals and glasses	301	257
Food and catering	2,540	5,497
Construction	1,696	3,112
Information and communication technologies	4,069	3,437
Waste and water	821	879
Medical and precision instruments	1,020	756
Other procurement	1,223	1,668
Unclassified	290	0
Total	***21,636***	***26,152***

3.6.5 Travel – Business related plus daily commuting for Staff and Students

Scope 3 emissions for Travel include Staff and Student Business Travel, Staff Daily Commuting and Student Term Time Daily Commuting. Full data analysis was completed for the first time for the year 2012/13.

- ***Staff and Student Business Travel*** – Available data covers a financial breakdown only of Annual Business Expenses for Staff and Students – Air Travel, Rail, Grey Fleet (Private Car use) and Taxi only. An assessment of journeys made and distance travelled for each category was carried out and the latest relevant Defra / DECC carbon emission conversion factor used to calculate the carbon emission. Assessed journey details, modal split and Scope 3 emissions are shown in the following table:

Staff and Student Business Travel DATA 2012/13 and 2013/14				
Modal Type	**2012/13**		**2013/14**	
	Miles	**tCO_2e**	**Miles**	**tCO_2e**
Air	391,013	156.1	378,238	151
Rail	88,126	6.9	89,403	7
Grey Fleet (Private Car)	225,862	69.2	218,681	67
Taxi	13,890	3.4	12,256	3
Total	***718,891***	***236***	***698,578***	***228***

- ***Staff Commuting*** – Using data from the staff Car Parking Permit scheme, the latest Staff Travel Survey and home postcode information it has been possible to calculate a total annual mileage figure based on 5 return journeys per week for 45 weeks. Using the modal split data from the Travel Survey, journey distances for each mode were calculated. A check on data credibility was carried out using the Parking Permit data which confirmed the Car Travel mode percentage as correct. The carbon emissions were then calculated using the latest relevant Defra / DECC carbon emission conversion factor. Assessed journey details, modal split and Scope 3 emissions are shown in the following table:

Staff Commuting Journey DATA 2012/13 and 2013/14				
Modal Type	**2012/13**		**2013/14**	
	Miles	**tCO_2e**	**Miles**	**tCO_2e**
Bus	812,579	108.1	793,078	105.5
Car Share	812,579	124.4	793,078	121.4
Cycle	1,320,442	0	1,288,751	0
Car	9,243,091	2,829.7	9,021,257	2761.8
Motorcycle	253,931	48.6	247,837	47.4
Train	660,221	51.8	644,375	50.6
Underground	1,320,442	134.4	1,288,751	131.2
Walk	1,879,090	0	1,833,992	0
Other	0	0	0	0
Total	***16,302,375***	***3,297.00***	***15,911,118***	***3,217.90***

- ***Student Commuting*** – Term time accommodation postcode information along with the Student Travel Survey data was used in the calculation for total annual journey mileage. The final data was for 14868 Full Time and 1942 Part Time Students. Using the data it was possible to calculate a total annual mileage figure based on 3 return journeys per week for 28 weeks (Full Time) and 14 weeks (Part Time). Using the modal split data from the Travel Survey, journey distances for each mode were calculated. The carbon emissions were then calculated using the latest relevant Defra / DECC carbon emission conversion factor. Assessed journey details, modal split and Scope 3 emissions are shown in the following table:

Student Commuting Journey DATA 2012/13 and 2013/14				
Modal Type	**2012/13**		**2013/14**	
	Miles	**tCO_2e**	**Miles**	**tCO_2e**
Bus	2,130,664	283.4	2,068,875	275.2
Car Share	71,022	10.9	68,963	10.6
Cycle	2,059,642	0	1,999,913	0
Car	2,130,664	652.3	2,068,875	633.4
Motorcycle	71,022	13.6	68,963	13.2
Train	996,086	78.2	967,199	75.9
Underground	2,626,044	267.3	2,549,889	259.5
Walk	7,954,481	0	7,723,801	0
Other	71,022	0	68,963	0
Total	***18,110,648***	***1,305.70***	***17,585,439***	***1,267.80***

3.6.6 Total Scope 3 Emissions Calculated for 2012/13 and 2013/14

Using the information above the calculated Scope 3 emissions are detailed in the following table:

Scope 3 Emissions - Totals		
Scope 3 Item	***2012/13 tCO_2e***	***2013/14 tCO_2e***
Water	142.2	146.9
Waste Water	290.7	300.3
Waste	28.3	27.3
Procurement	21,636	26,152
Business Travel	236	228
Staff Commuting	3,297	3217.9
Student Commuting	1,305.7	1267.8
TOTAL	***26,935.9***	***31,340.2***

3.7 Scope 1, 2 & 3 Carbon Emissions 2012/13 and 2013/14

The total carbon emissions for the years 2012/13 and 2013/14 are detailed in the following table:

Scope 1, 2 & 3 Carbon Emissions		
Detail	***2012/13 tCO_2e***	***2013/14 tCO_2e***
Scope 1	7,957	6,682
Scope 2	11,174	11,507
Scope 3	26,936	31,340
Total Carbon Emissions	**46,067**	**49,529**

3.8 Targets for Scope 1, 2 & 3 Carbon Emissions

Targets and Milestones for Scope 1 & 2 emissions have now been bought in to line with the revised suggested values from HEFCE published in *"Carbon Reduction Target and Strategy for Higher Education in England".* They are:

- 2017/18 Milestone 35% reduction from a 2005/06 carbon emission baseline
- 2020/21 Target 43% reduction from a 2005/06 carbon emission baseline
- 2050 Target 83% reduction from a 2005/06 carbon emission baseline

The available Scope 3 data, excluding water, waste water and waste, are in their infancy and, therefore, do not indicate trends and prevent sufficient analysis for targets to be developed. However, it is anticipated that by 2015/16 that sufficient mature data will be accrued enabling relevant targets to be developed.

3.9 Future Campus Development

The ongoing and future development planned for the Campus includes replacement and additional facilities aimed at meeting the aspirational needs of Brunel. These are outlined below:

In Hand Current

- Bio Annexe Phase 1
- Wilfred Brown Redevelopment – completion 2016
- CSEFC
- Runnymede Boathouse
- Data Centre 1 Relocation

Tranche 1

- Redevelopment of the Engineering Complex – 2015 to 2020
- Sport and Wellbeing Centre – 2015 to 2018
- AMCC 1 & 2 – 2015 to 2017
- Demolition of John Crank

Tranche 2 (still under consideration)

- Learning & Teaching Centre
- AMCC 3 – 2018 to 2021
- Residential Accommodation (third party funder) – 2018 to 2021
- Hamilton Centre Redevelopment – 2019 to 2021
- New Energy Centre – 2018/19

These Projects will all have an effect on the current and future carbon emissions impacting on the emissions reduction target of 43%, either positive, negative or neutral.

The potential estimated impact of these Projects is shown in *4.5 Impact of Future Developments*.

4 Implementation

4.1 Activity since September 2010

The Carbon Management Plan approved by Brunel in September 2010 stated that funding for the identified projects are taken from:

- Brunel Stock Condition Budget £2.1M
- The Rolling Green Fund (Salix) £500k
- Energy savings reinvested £70k

And the Projects carried out included:

- Voltage Optimisation
- Lighting Replacement
- Mechanical Plant Replacement
- Window Replacement
- Hand Dryer Replacement
- Programmable eTRV Head Replacement
- Burner Management Control
- Switch Off Campaigns and Attitude Change
- Waterless Urinals
- Urinal flushing controls
- Building Energy Management System installation and improvements
- Integration of energy efficiency features in new buildings
- Maintenance of boilers and other plant to a high standard
- End of life HVAC equipment replaced with more energy efficient options
- Automatic (presence detection) and daylight dimming lighting controls
- Undertaken energy surveys on many buildings
- Investment in an energy Monitoring and Targeting system
- Phased installation of automatic meter reading equipment – Electricity, Gas & Water
- Switch Off campaigns & Attitude/Behavioural Change

These are estimated to have delivered combined savings in excess of 2,500 tonnes CO_2e with an approximate total investment to date of £6,500,000.

The Rolling Green Fund, as a self-perpetuating fund, will continue to be invested and resultant carbon emission reductions of 608 tCO_2e are expected to be achieved by 2020/21.

4.2 Emission Reduction Opportunities

The purpose of this section of the plan is to list and prioritise all of the opportunities identified for carbon emissions savings and sustainable practices which have been collected from suggestions made at a series of workshops with the Carbon Reduction Action Group (CRAG).

Each Workshop was tailored to producing project opportunities that would either directly or indirectly reduce the carbon emissions from Brunel. Some opportunities may reduce carbon emissions outside of the emissions accounted for within the baseline but these are given equal priority as it is expected that the baseline will expand in the future to include emission sources previously unaccounted for. There are also opportunities for influencing emissions of activities outside of Brunel itself, these are also considered as they fall within Brunel's environmental obligations and obligations to the wider community.

The identified opportunities have been categorised into three types:

Abatement projects – projects (of whatever scale of investment) that lead to measureable reductions in emissions.
Feasibility projects – projects with the objective of determining the scale and cost of potential future projects.
Embedding projects – projects or actions which do not themselves reduce carbon emissions, but which have the effect of facilitating or causing the reduction of emissions through further actions (e.g. policies and procedures)
Term – short, medium and long term refer to the period over which the action is undertaken, not the period over which emissions reductions are realised.

Each project has been given an overall ranking based on the following scoring table:

Cost – *Low to High*		Saving – *High to Low*		Payback		Ease of Implementation		Potential Carbon Saving	
£	20 points	£££££	20 points	> 2 years	20 points	1	20 points	1	30 points
££	15 points	££££	15 points	>4 years	15 points	2	15 points	2	25 points
£££	10 points	£££	10 points	>6 years	10 points	3	10 points	3	20 points
££££	5 points	££	5 points	>8 years	5 points	4	5 points	4	15 points
£££££	0 points	£	0 points	<8 years	0 points	5	0 points	5	10 points

Short Term Abatement Projects

Opportunity	Cost	Saving	Payback	Ease of Implementation	Potential Carbon Saving	Overall Ranking Points
Carry out a full review of the Building Management Systems (BMS) in respect of temperature set points, time schedules, optimiser settings and compensation slopes etc.	~~£~~£	~~£~~£~~£~~£	>1 year	1	2	95
Improve pipe work insulation and fit valve covers / jackets etc. as necessary	~~£~~£	~~£~~£~~£~~£	1-2 years	1	2	95
Replace fan units in older air handling units with modern high efficiency models reducing electricity consumption	~~£~~£~~£~~	~~£~~£~~£~~£	3-4 years	1	1	90
Improved zoning of heating systems in some buildings	~~£~~£~~£~~	~~£~~£~~£~~£	2-3 years	1	1	90
Draught stripping in buildings with poorly fitting windows and doors	~~£~~£	~~£~~£~~£~~	3-4 years	1	2	85
Fit timers to water coolers/water boilers/vending machines/office equipment etc.	£	~~£~~£~~£~~	>1 year	1	2	80
Install PIR presence detectors in lecture theatres and shared teaching rooms to control plant and lighting	~~£~~£~~£~~	~~£~~£~~£~~	3-4 years	1	2	80
General installation of lighting controls working via presence detection and/or ambient light levels	~~£~~£	~~£~~£~~£~~	3-4 years	1	3	80
Replace existing light fittings with high efficiency *SMART* type fittings	~~£~~£~~£~~	~~£~~£~~£~~£	>5 years	1	2	80
Improve control of heating through the use of replacement eTRV heads on radiators	~~£~~£~~£~~£	~~£~~£~~£~~£	>4 years	2	2	80

Medium Term Abatement Projects

Opportunity	Cost	Saving	Payback	Ease of Implementation	Potential Carbon Saving	Overall Ranking Points
Install water saving / spray type taps and shower heads in all sinks and showers	~~£~~£	~~£~~£~~£~~£	1-2 years	1	4	85
Improve roof insulation to buildings	~~£~~£~~£~~	~~£~~£~~£~~	3-4 years	2	2	75
Consider upgrading to reduced water enzyme controlled urinals where appropriate	~~£~~£	~~£~~£~~£~~	> 1 year	4	4	75
External lighting control to be reviewed	~~£~~£	~~£~~£	3-4 years	2	3	60
Install blinds/solar film in areas where solar gain is encouraging the use of fans or air conditioning	~~£~~£~~£~~	~~£~~£	3-4 years	3	3	60
Automatic Smart Meter Reading System for all utilities. A start has been made with some electricity meters of this type already being installed	~~£~~£~~£~~	£	5-6 years	2	4	50
Consideration to be given to limited local control of centrally controlled services e.g. temperature control of plus or minus 3 degrees around set point	~~£~~£~~£~~	£	8+ years	2	5	35

Long Term Abatement Projects

Opportunity	Cost	Saving	Payback	Ease of Implementation	Potential Carbon Saving	Overall Ranking Points
Replacement of older style fume cupboards with low face velocity type thereby considerably reducing the loss of heated air from the buildings	£££££	~~£~~£££	1-2 years	3	2	70
Replace all kettles with appropriately located fixed hot water units	~~£~~£	~~£~~£	4-5 years	3	2	55
Reducing the use of the 25 litre drinking water bottles for provision of chilled water by providing plumbed in chilled water units	~~£~~£~~£~~	~~£~~£	4-5 years	3	3	55
External Lighting to be changed to LED	~~£~~£~~£~~	~~£~~£~~£~~	4-5 years	3	3	55
Use solar thermal panels to provide hot water preheating and if suitable cooling in summer via absorption chillers dependant on roof space	~~£~~£~~£~~£	~~£~~£~~£~~	6-7 years	4	2	50
Install power factor correction / harmonics correction equipment	~~£~~£~~£~~£	~~£~~£	6-7 years	2	3	50
Fit secondary glazing to buildings with very poorly fitting windows. Replacement windows to be double glazed - 'K glass' or equivalent	£££££	~~£~~£~~£~~	8+ years	4	3	40
Fit over cladding systems to older buildings facades to improve fabric insulation levels	£££££	~~£~~£~~£~~	8+ years	5	3	35

Short Term Feasibility Projects

Opportunity	Cost	Saving	Payback	Ease of Implementation	Potential Carbon Saving	Overall Ranking Points
Use LED lighting with presence and ambient light level controls for stairwells, corridors, toilets, kitchens, lifts and other public areas	££	££	4-5 years	2	2	70
Investigate the additional possibilities for voltage reduction ideally by tap changing at the transformer or through specialist designed equipment	£££	££	4-5 years	2	3	50

Medium Term Feasibility Projects

Opportunity	Cost	Saving	Payback	Ease of Implementation	Potential Carbon Saving	Overall Ranking Points
Use student resources to consider most effective ways of increasing student recycling rates	~~£~~£	~~£~~£	4-6 years	2	3	75
Extending the provision of metered charging points for privately owned electric vehicles	~~£~~£	~~£~~£~~£~~	7-8 years	2	3	65
Carry out thermo graphic survey of all buildings	~~£~~£~~£~~	~~£~~£~~£~~	4-5 years	3	3	60
Consider energy efficiency of washing durable plates and cutlery versus use of disposable but compostable alternatives	~~£~~£~~£~~	~~£~~£~~£~~	4-6 years	4	2	60
Tree planting on remote sites	~~£~~£	~~£~~	N/A	3	2	50
Installation of wind turbine	~~£~~£~~£~~£~~£~~	~~£~~£~~£~~£~~	7-8 years	5	2	45

Long Term Feasibility Projects

Opportunity	Cost	Saving	Payback	Ease of Implementation	Potential Carbon Saving	Overall Ranking Points
Investigate the use of micro bio-digestion plant for kitchen waste	~~£~~£££	~~£~~££	2-4 years	4	1	65
Trial installation of fuel cell and/or bio fuel heat and power generation	~~£~~£££	~~£~~£££	5-6 years	4	2	60
Development of a Centralised Combined Heat and Power installation potentially in co-operation with a third party organisation	~~£~~£££££	~~£~~£££	8+ years	4	1	50
New fleet vehicles to be hybrid or electric	~~£~~£££	~~£~~£	5-6 years	3	4	50
Consider suitability of buildings for green/brown roofs	~~£~~£££	~~£~~£££	6-8 years	4	3	45
Soft start system for areas with high lighting loads	~~£~~£££	~~£~~£	5-6 years	4	4	45
Install photovoltaic cells and make use of their location such that they can also provide solar shading	~~£~~£££££	~~£~~£££	8+ years	4	2	40
Consider incorporation of sustainable urban drainage systems in surfaced courtyard and car park areas	~~£~~£££	~~£~~£	N/A	3	4	35
Make windows openable by occupants to reduce cooling requirements	~~£~~£££	~~£~~£	8+ years	4	5	25
Explore utility meter validation systems or equipment	~~£~~£££	~~£~~£	8+ years	4	5	25

Short Term Embedding Projects

Opportunity	Cost	Saving	Payback	Ease of Implementation	Potential Carbon Saving	Overall Ranking Points
Implement energy and water conservation awareness campaign	~~£~~£	~~£~~£~~£~~£	1-2 years	1	2	95
Institution wide PC shutdown arrangements overnight and weekends etc.	~~£~~£	~~£~~£~~£~~£	1-2 years	2	2	90
Make turning all non-essential lights off at the end of building opening hour's as part of security/cleaning staff's duties	£	~~£~~£	> 1 year	1	4	80
Improve facilities for cyclists, secure parking, showers etc.	~~£~~£	£	N/A	2	4	45

Medium Term Embedding Projects

Opportunity	Cost	Saving	Payback	Ease of Implementation	Potential Carbon Saving	Overall Ranking Points
Ban the use of supplementary heaters except in cases where normal services have failed	£	£££	>1 year	3	2	85
Liaise with departments in respect of locating their equipment e.g. fridges to minimise services provision requirements such as air conditioning	£	£££	1-2 years	3	2	85
Inclusion of Carbon Management Plan or extracts from it in the student prospectus	£	£££	2-3 years	2	3	80
Check room booking system to ensure services are not provided to centrally booked rooms when not in use	£	££	2-3 years	1	3	80
Set limit/target for energy consumption in each building	££	££££	3-4 years	3	2	80

Long Term Embedding Projects

Opportunity	Cost	Saving	Payback	Ease of Implementation	Potential Carbon Saving	Overall Ranking Points
Continually updating the Carbon Management Plan beyond the initial period in light of changing circumstances	£	£££	2-4 years	1	3	85
Appoint a full time Building Management System operative to ensure that correct settings are maintained for all plant controls	££££	££££	1-2 years	3	2	75
Increase provision of recycling facilities especially near catering outlets	££	££	5-6 years	2	3	75
Revise procurement policy for computer purchases to allow upgrading rather than replacement of equipment	£	££	> 1 year	3	3	75
Consolidating orders for the supply of building and maintenance materials etc. in order to reduce the number of deliveries	£	£	N/A	4	3	45
Find markets /users of redundant materials rather than throwing away potentially useful items	££	£	N/A	3	3	45
Explore methods and costs of carbon offsetting	££££	£	N/A	5	1	35
Use natural products or recycled materials for flooring etc.	£££	£	N/A	3	4	35
Provide opportunities to work from home when appropriate	£	£	N/A	4	5	15

4.3 Shortlisted actions and implementation plan summary

Based on a review of the full table in the previous section, the shortlisted actions to be undertaken during the early stages of this plan comprise the short term measures identified in all three categories (abatement, feasibility, embedding) and all 17 are summarised in the list below for clarity. There are three types of project that are (due to the very large building stock covered by this plan), repeatable at the same level over the next five years. These are the BMS Review of each building/installation and the resultant implementation (*Project 1*), the fitting of insulation jackets to valves and flanges in all plant areas (*Project 2*) and the upgrading of lighting installations using smart fittings and or LED with presence and ambient light level control (*Project 8, 9 & 12*).

The medium and long term measures identified in the emission reduction opportunities list, which is expected to be supplemented and refined in the coming months and years, will be fully appraised within the next year.

Abatement Projects

	Project Description
1	Review of Building Management System control settings
2	Fit insulation jackets to valves and flanges on services pipe work
3	Upgrade fan units on Air Handling Units
4	Improve zoning of heating systems
5	Install draught strips on doors and windows
6	Fit timers to water coolers, water boilers and general office type equipment
7	Presence detector control of lighting and plant in lecture theatres
8	Presence and ambient light level control of lighting
9	Replace existing light fittings with high efficiency *SMART* type fittings
10	Improve control of heating through the use of replacement eTRV heads on radiators
11	Automatic Smart Meter Reading System

Feasibility Projects

	Project Description
12	Use LED lighting with presence and ambient light level controls for common areas
13	Install voltage reduction / stabilisation equipment

Embedding Projects

	Project Description
14	Energy and water conservation awareness campaign
15	Institution-wide PC shutdown arrangements
16	Make turning all non-essential lights off at the end of building opening hour's as part of security/cleaning staff's duties
17	Improve facilities for cyclists by providing additional parking, showers etc.

All of the above 17 projects are described in some detail in *4.4* below. The information provided includes:

- Description and Notes
- Financial Investment / Savings
- Carbon Savings
- Other Benefits

The financial savings arising from each project have been calculated using current unit rates for each utility. However, prices are expected to rise steeply on especially in the case of electricity. Indeed all forecasts indicate steep rises in energy costs over the coming years and into the

foreseeable future. Therefore the savings indicated should be regarded as conservative but the volatility of the energy markets is such that trying to predict future prices with any certainty is impossible, effectively making the use of today's prices the only realistic option.

Estimating the emissions from each source is carried out by applying the appropriate CO_2e emissions factor to each unit used of each utility. These emissions factors are provided by Defra/DECC and are shown in the table below and were used to estimate the carbon savings associated with each project.

Fuel	Conversion Factor	
Electricity	0.473935	kilograms CO_2e/kWh
Gas	0.184973	kilograms CO_2e/kWh
Water	0.3441	kilograms CO_2e/m^3
Waste Water	0.7085	kilograms CO_2e/m^3

4.4 Next Steps

All of the 17 listed projects are detailed in full below:

Project 1 *- Ongoing*
Carry out a full review of the Building Management Systems (BMS) in respect of temperature set points, time schedules, optimiser settings and compensation slopes etc.

Description
The current average age of individual BMS installations in buildings on the Campus is 10 years+. Methods of control and measurement have improved enormously over the period and the existing installations would benefit greatly from a review. The review needs to take in to consideration the current use and operational times of the building and/or facility and the suitability of existing operation programme, control equipment, sensors, controllers, zone valves, etc. It is estimated that up to 10 to 15% of a buildings heat energy consumption could be saved through carrying out the review and implementing the findings.

Cost and Funding
A survey covering the above could be implemented for approximately £1,200 per building. Total cost for 40 Non-Residential Buildings and 37 Residential Buildings = £116,400. The surveys are recommended to be carried from 2014/15 onwards and funded from the proposed Energy Reduction budget. An initial allowance of approximately £35,000 should be allowed for initial implementation of findings.

Carbon Reduction
Taking a conservative estimate of an overall 10% saving in heating energy this would equate to 2.7 million kWh gas and 500 tCO_2e over the next 5 years (approximately 100 tCO_2e pa)

Simple Payback
>1 year

Project 2 *- Ongoing*
Improve pipe work insulation and fit valve covers / jackets etc. as necessary

Description
All Heating and Hot Water Service Plantrooms have the pipework currently insulated, usually with ridged section aluminium clad insulation. This insulation sometimes includes valves, strainers and flanges etc. However many of these have no insulation jackets or boxes fitted or are missing having been removed for maintenance activities. In addition pipework insulation can be damaged and/or missing completely. An initial survey is required to ascertain the level of wrap-around valve insulation jackets or boxes required to insulate heating and hot water service valves, strainers and flanges etc. as necessary. In addition damaged and/or uninsulated pipework needs to be identified and remedial work carried out

Considerable energy savings would result from the reduction in heat loss achieved from the use of easily applied wrap-around insulation jackets.

Cost and Funding
It is estimated that a full initial campus survey and resultant work would cost approximately £100,000 and be funded partially from the RGF and the proposed Energy Reduction budget. Annual inspections should be carried out and remedial work implemented at an estimated cost of £20,000 pa for a 5 year period. The implementation is recommended to start from 2014/15 onwards.

Carbon Reduction
An overall 1.5% saving in heating energy would be expected which equates to 450,000 kWh gas and 100 tCO_2e over the next 5 years (approximately 20 tCO_2e pa).

Simple Payback
>2 years

Project 3
Replace fan units in older air handling units with modern high efficiency models reducing electricity consumption

Description
Motor and fan design has improved over the years and some of the existing fan units (supply and extract) are at least 40 years old. Fans and motor units can be specifically designed to be retrofitted to existing air handling units and plant especially if the majority of the equipment does not need to be replaced.

Cost and Funding
Dependent on size of unit cost could be up to £60,000. Funding would be from LTM or SCW budgets.

Carbon Reduction
A reduction of up to 15% would be expected dependent on unit size.

Simple Payback
Would be >4 years

Project 4
Improved zoning of heating systems in some buildings

Description
Many buildings have two separate distinct heating circuits – constant temperature for central common areas usually with radiators and/or heat emitters fitted with some form of thermostatic control and variable temperature for distinct separate areas where the supply water temperature is controlled by the BMS in relation to the external ambient temperature. The creation of these areas or zones can be based on orientation and/or use enabling different heating medium temperatures to be provided preventing under or over heating or providing heating to a space reflecting its use pattern ie a teaching area. Improvements to zoning are through the introduction of motorised control valves enabling the isolation of heating or its flow temperature supported by adequate numbers of space temperature sensors and the correct programming of the controlling BMS building outstation.

Cost and Funding
Creating zones or extending them in buildings with existing heating installations is not a simple task and is best implemented when refurbishment takes place. It is not possible, therefore, to produce estimated costs. Funding would be from LTM or SCW budgets.

Carbon Reduction
A reduction of up to 15% would be expected depending on system complexity.

Simple Payback
Would be >3 years.

Project 5
Draught stripping in buildings with poorly fitting windows and doors

Description
Many of the existing 60s and 70s buildings on the campus have single glazed openable metal framed windows and doors. The major problem is poor draught proofing around the frame exacerbated by constant opening and closing especially for doors causing draughts and subsequent heat loss. Purpose made draught stripping products designed to adequately seal gaps can be fitted. This can only be considered as a semi-permanent stop gap solution due to potential regular window and door operation. A more permanent solution is to replace windows completely with double or triple glazed units carried out under building refurbishment. For doors air locks with inner doors can be created and this work would also usually be carried out under refurbishment.

Cost and Funding
To enable accurate costings to be developed surveys for each building would be required. Funding would be from the SCW budget.

Carbon Reduction
A reduction of up to 10% would be expected depending on extent of works.

Simple Payback
Would be >4 years

Project 6
Fit timers to water coolers/water boilers/vending machines/office equipment etc.

Description
The majority of office related equipment, including water cooling and vending, are powered for 24 hours - 365 days. The usual office occupation times are between 8am and 6pm Monday to Friday – a total of 50 hours. This means that the equipment is dormant or unused for 118 hours per week which is 8736 hours per year. Dependant on use a water boiler, for instance, would use 500 watts to maintain temperature for instant use per dormant hour, which is an annual total of 4368 kWh (at current cost of 12.5p/kWh - £546pa). If University closures of up to 10 days per annum are also factored in the overall wasted electricity use would increase to 5500 kWh at a cost of £690. There are potentially 80 water boilers installed across the campus with a possible wastage of 440000 kWh per annum at a cost of £55,000. Water boilers can be considered as the worst case scenario; therefore, savings would be less for small power use equipment, however, taken across the campus the savings would be substantial. Simple timers, plug in or fixed, would be provided and programmed to suit local use patterns.

Cost and Funding
This would be estimated as between £100 to £200 per unit and funded from RGF budget.

Carbon Reduction
Between 0.25 to 2 tCO_2e dependant on equipment controlled.

Simple Payback
Would be >1 year

Project 7
Install PIR presence detectors in lecture theatres and shared teaching rooms to control plant and lighting

Description
The Lecture Centre is heated and ventilated from 6am through to 9pm 7 days a week which reflects actual and potential use of its facilities ie meeting and teaching rooms and lecture theatres. The booking of the majority of its space is done so at the beginning of the academic year with the assumption that teaching and lectures will take place throughout the year according to the timetable. As the year progresses many such bookings are not fulfilled and spaces remain empty but heated and ventilated and in many cases lit. The same scenario occurs across the campus in all of the buildings used for teaching. By including within the control system for the services a form of presence detection, a PIR detector for instance, which will only activate the service when people are registered in the space. This ensures that heating, ventilation and lighting are only used when the space is actually occupied.

Cost and Funding
The description above is very simplistic and the actual addition of this form of control will depend solely on the existing services installation and the ease in which it can be added. Additional zoning of the heating system, as described in an earlier Project, may well be part of the answer. Dependant on complexity, therefore, this form of control would need to be carried out during a building refurbishment and be funded from the SCW budget.

Carbon Reduction
Savings between 15 and 25% can be expected.

Simple Payback
Would be <4 years

Project 8 *- Ongoing*
General installation of lighting controls working via presence detection and/or ambient light levels

Description
The control of lighting within a space by the occupants is usually limited to switching them on; the actual task of switching off is usually overlooked. Human nature is such that despite being reminded either through campaigns or signs the simple task of switching off very rarely occurs. The simplest method of achieving a switch off is to utilise a form of presence detection control or PIR. Also many areas can be over lit especially when existing daylight is taken in to consideration and suitable control can be simply installed to regulate the light levels from fittings. Both of these functions can be combined in an added installed sensor or an integral one built in to a light fitting such as the *SMART* fitting. A project covering the Towers, Halsbury, Howell and John Crank buildings was carried out in summer 2012 with an approximate overall electricity consumption reduction of 10% being recorded.

Cost and Funding
Dependant on the method used to provide presence and ambient light level control the estimated cost for a single small space installation would be:

Standalone unit(s) - £500 each
Integral unit (s) – included in the cost of the *SMART* fitting

Funding would be available from the RGF and proposed Energy Reduction budgets.

Carbon Reduction
A carbon reduction of up to 70% of the controlled installed electricity lighting load can be expected.

Simple Payback
Would be 5 years

Project 9 *- Ongoing*
Replace existing light fittings with high efficiency *SMART* type fittings with integral ambient light level control and presence detection.

Description
The Campus lends itself to either wholesale or piecemeal replacement of lighting in buildings and / or offices. A range of light fittings (T5 fluorescent and LED) has been trialled which can operate either as a single unit or a number of fittings in a large space or building with integral controls linked.

Cost and Funding
The majority of projects can be funded from the RGF but may, in some instances, require additional funding from SCW budget. Cost of a fitting and installation can be as low as £200 and up to £400 dependent on type and situation. It is not possible, therefore, to give outline project costings in this instance.

Carbon Reduction
Dependent on location and situation reductions up to 70% can be attained.

Simple Payback
The majority of lighting replacement projects will have a payback <5 years.

Project 10 *- Trial completed*
Improve control of heating in Residential Halls through the use of replacement eTRV heads

Description
The University's Space Temperature Policy states that "Residential buildings will be maintained at a minimum of 19°C during periods of occupation **in the day (8:30 am to 23:00) with a temperature set back of 14°C during the night** to reduce energy consumption and improve sleeping conditions". In 90% of the Residential Halls the control of ambient space temperature utilises a Thermostatic Radiator Valve head (TRV) which can be set between 5^{o}C and 25^{o}C and fixed although many of the end users have overridden this. Occupiers have a fixed term agreement and have use of the room throughout University closure periods although many students are not in constant occupation throughout these periods and some weekends. This means that even when rooms are not occupied they are at the set ambient temperature. In an attempt to alleviate this overheating and wasted heating a trial in one third of the suitable Halls of Residence has been implemented utilising a pre-programmed eTRV head linked with a presence detector. The eTRV has three settings Set Back 17^{o}C – Normal 19^{o}C – Boost 21^{o}C. Where no presence in the space is detected the eTRV goes to *"Set Back"*, when the heating is on and presence is detected the eTRV goes to *"Normal"* and if required the occupant can activate the *"Boost"* setting for an hour. The initial results indicate a reduction of approximately 30%. It is proposed therefore that the trial be extended to cover the remaining two thirds of the suitable Halls of Residence. It is further recommended that eTRV heads are also retrofitted in office and administration areas to produce finer temperature control.

Cost and Funding
Based on the trial the cost would be approximately £600,000.00 with funding from SCW or Capital budgets.

Carbon Reduction
Reductions of approximately 300 tCO_2e

Simple Payback
Would be >4 years

Project 11 *- Current ongoing*
Automatic Smart Meter Reading (ASMR) System

Description
Electricity, gas and water supplied to the campus is metered at every incoming supply point. They are also sub-metered as they enter many of the buildings on the campus. By sub-metering it is possible to measure the electricity, gas and water used per building enabling ongoing monitoring and consumption targeting to be implemented. Sub-metering needs to be installed or upgraded to enable the metering data to be collected and this project is being delivered in 3 Phases:

Phase 1 – Procure and install required computer hardware and software system and modify existing suitable electricity sub-meters and link to ASMR system - programmed completion December 2014 - Replace remaining suitable sub-meters requiring building shutdowns and link to ASMR system – revised programme completion February 2015

Phase 2 – Install water sub-meters in all buildings and link to ASMR system, link all other suitable existing sub-meters to ASMR system - programmed completion July 2015

Phase 3 – All other existing electricity sub-meters not included in Phases 1 & 2 to be replaced and / or modified and linked to ASMR system - programmed completion July 2015

Cost and Funding
Current estimate is £1,200,000 over three years funded from the Capital Works budget

Carbon Reduction
The Carbon Trust estimate a 5% reduction in energy consumption can be achieved from utilisation of the data received from an AMT system (approximately 1000 tCO_2e)

Simple Payback
Would be >6 years

Project 12 *- Ongoing*
Use LED lighting with presence and ambient light level controls for stairwells, corridors, toilets, kitchens, lifts and other public areas

Description
LED lighting can still be considered in its infancy and is still undergoing development of products. This is very much the case for lighting in specialist areas, offices, laboratories, etc. However for stairwells, corridors, toilets, kitchens, lifts and other public areas LED is a suitable form of lighting. It is also eminently suitable for automatic lighting level control and presence detection working together. As many of these common areas are lit 24 hours the controls are able to reduce the light level down to a preset minimum or off completely when not required producing reductions in electricity consumption by up to 70%.

Cost and Funding
The majority of projects can be funded from the RGF but may, in some instances, require additional funding from SCW budget. Cost of a fitting and installation can be as low as £200 and up to £400 dependent on type and situation. It is not possible, therefore, to give outline project costings in this instance.

Carbon Reduction
Dependent on location and situation reductions up to 70% can be attained.

Simple Payback
Would be <5 years

Project 13
Investigate the additional possibilities for voltage reduction ideally by tap changing at the transformer or through specialist designed equipment

Description
Modern small power and lighting equipment is designed to operate between 220 and 250 volts single phase and generally metered energy consumption is lower if the supply voltage is between 200 and 230 volts single phase. The supply voltage is usually supplied at the higher end of the range to ensure that large complexes and buildings have an adequate supply voltage throughout. The supply voltage is controlled at the incoming sub-station where electricity is converted through a transformer from High Voltage to Low Voltage and can be changed at the transformer, called a Tap Change (T), at a fixed value. If this fixed value is to low the voltage drop at the farthest point may mean the supply voltage is below 220 volts. Specialist Voltage Optimisation (VO) equipment is also available which will reduce the incoming voltage to a building down to a pre-set level and maintain it no matter what the load. However both systems require data on the level of the supply voltage to be carried out over a period to ascertain the correct minimum supply voltage required.

Cost and Funding
Dependant on the method chosen to suit a building and its use:

Transformer TC - £1000 plus
VO Equipment – up to £50,000 depending on electricity use

Funding from proposed Energy Reduction budget or SCW budget

Carbon Reduction
Reductions between 5 and 10% would be expected

Simple Payback
Would be >5 years

Project 14
Implement energy and water conservation awareness campaign

Description
To reduce energy and water use through human intervention requires ongoing awareness raising and behavioural change campaigns. The campaigns need to be designed specifically for their target audience and can use many different forms of communication currently available.

Cost and Funding
Both awareness raising and behavioural change campaigns require ongoing funding streams to maintain the necessary ongoing momentum. This is due to the constant turnover of students as well as staff and, of course, the human trait of reverting back to the easy option. Funding from the proposed Energy Reduction Budget

Carbon Reduction
The Carbon Trust state that successful campaigns can reduce energy consumption by up to 10%. For electricity alone this would be 1150 tCO_2e.

Simple Payback
Would be >2 years

Project 15
Institution wide PC shutdown arrangements overnight and weekends etc.

Description
Like many businesses and other HE institutions there is a great reliance on PCs and electronic technology and at Brunel there are over 5000 desk top PCs in constant use. Many of these PCs and their associated monitors are left on idle at night and over weekends and holiday periods. Investment has already been made in software specifically designed to remotely control a PC enabling it to have software updates added along with being shut down when it is idle. Unfortunately the Computer Centre only has operational control over 2000 of these PCs as the balance are purchased and operated by the Colleges and Institutions. By obtaining remote access control over these PCs it would be possible to shut them down when they are idle overnight and at weekends. This has to be carried out with operational need in mind to allow necessary operation to continue unimpeded.

Cost and Funding
The cost to extend the current *Energywise* programme would be approximately £100,000. Funding from the proposed Energy Reduction Budget

Carbon Reduction
Reductions of approximately 250 tCO_2e

Simple Payback
Would be >2 years

Project 16
Make turning all non-essential lights off at the end of building opening hour's as part of security/cleaning staff's duties

Description
By arranging for Security and/or Cleaning staff to turn off lights when they leave a building, will work in conjunction with ongoing behavioural changes schemes. It will ensure that lighting is not left on inadvertently in an empty building.

Cost and Funding
Cost would be Zero

Carbon Reduction
A potential 5% saving could be achieved – approximately 600 tCO_2e

Simple Payback
Would be >1 year

Project 17
Improve facilities for cyclists, secure parking, showers etc.

Description
An important part of Brunel's Travel Plan is to encourage a move from car use to alternatives, such as walking, cycling and public transport. To support and encourage the move to cycling additional secure parking, drying facilities and showers would be provided on the Campus.

Cost and Funding
Approximately £100,000

Carbon Reduction
Scope 3 reduction

Simple Payback
N/A

Abatement Projects

Project Description		Cost £	Carbon tCO_2e
1	Review of Building Management System control settings	150,000	500
2	Fit insulation jackets to valves and flanges on services pipe work	100,000	100
3	Upgrade fan units on Air Handling Units (assume 10)	600,000	100
4	Improve zoning of heating systems	500,000	100
5	Install draught strips on doors and windows	200,000	25
6	Fit timers to water coolers, water boilers and general office type equipment (assume 200 items)	100,000	100
7	Presence detector control of lighting and plant in lecture theatres	500,000	100
8	Presence and ambient light level control of lighting	650,000	200
9	Replace existing light fittings with high efficiency SMART type fittings	1,000.000	500
10	Improve control of heating using programmable eTRV heads on radiators	600,000	300
11	Automatic Smart Meter Reading System	1,200,000	1,000
	TOTAL	**£5,600,000**	**3,025 tCO_2e**

Feasibility Projects

Project Description		Cost £p	Carbon tCO_2e
12	Use LED lighting with presence and ambient light level controls for common areas	500,000	200
13	Install voltage reduction / stabilisation equipment	250,000	100
	TOTAL	**£750,000**	**300 tCO_2e**

Embedding Projects

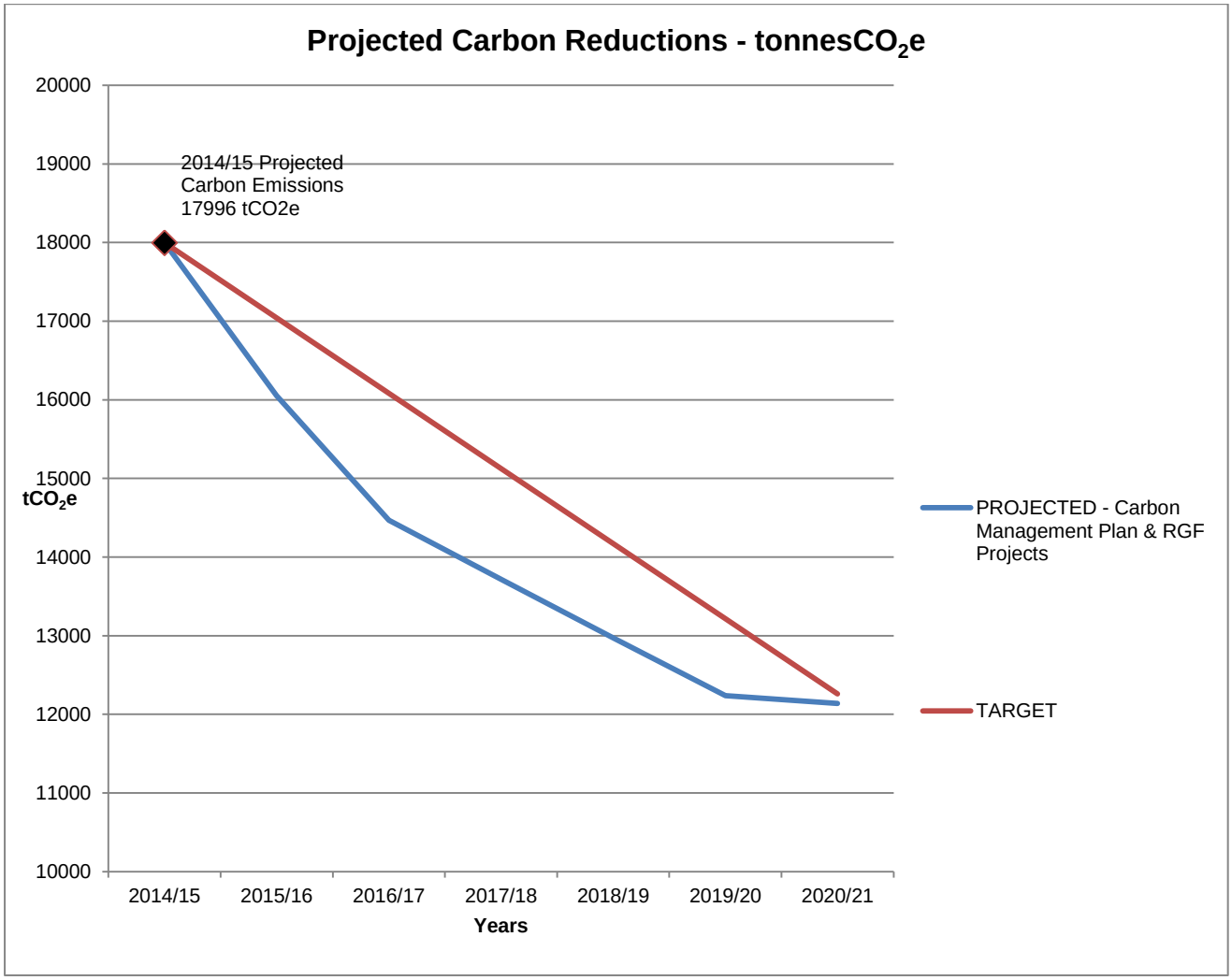
Project Description		Cost £p	Carbon tCO_2e
14	Energy and water conservation awareness campaign (5 Years)	10,000	1,200
15	Institution-wide PC shutdown arrangements (5 Years)	100,000	250
16	Make turning all non-essential lights off at the end of building opening hour's as part of security/cleaning staff's duties	0	600
17	Improve facilities for cyclists by providing additional parking, showers etc.	100,000	Scope 3 Only
	TOTAL	**£210,000**	**2,050 tCO_2e**

GRAND TOTAL	**£6,560,000**	**5375 tCO_2e**

Expected Carbon Reduction	**Gas – 1,025 tCO_2e** **Electricity – 4,350 tCO_2e**

The impact of the expected carbon emission reductions delivered by the implementation of the detailed 17 Projects is shown in the following table and graph, taking in to account the work being spread over 5 years. The data (in tCO_2e) also includes the emission reductions through the full investment potential of the Rolling Green Fund (expected to be 608 tCO_2e) in suitable additional projects.

	2015/16	***2016/17***	***2017/18***	***2018/19***	***2019/20***	***2020/21***
Abatement Projects	705	705	805	405	405	0
Feasibility Projects	60	60	60	60	60	0
Embedding Projects	590	590	290	290	290	0
Rolling Green Fund Projects	92	107	110	105	96	98
Total Project Reduction	***1447***	***1462***	***1265***	***860***	***851***	***98***



This clearly shows that if there is not an increase on the current energy consumption and related carbon emission, the 2020/21 target will be achieved with the implementation of the reduction projects. However, as outlined in *3.9* future development is planned to meet the growing aspirations of the University. The impact of these developments on future carbon emissions as well as targets is dealt with below.

4.5 Impact of Future Development

The Projects outlined in *3.9 Future Campus Development* will all impact positively or negatively on future energy consumption and, over all, have the effect of increasing carbon emissions. Each Project has been assessed and is detailed in the following tables and graphs.

In Hand Current Projects (in tCO_2e)

Project	***2015/16***	***2016/17***	***2017/18***	***2018/19***	***2019/20***	***2020/21***
Bio Annexe Phase 1	150	150	0	0	0	0
WBB	-360	300	0	0	0	0
CSEFC	60	60	0	0	0	0
Runneymede Boathouse	0	0	0	65	0	0
New Data Centre	0	0	0	0	0	0
TOTAL Emissions	***-150***	***510***	***0***	***65***	***0***	***0***

Tranche 1 Projects (in tCO_2e)

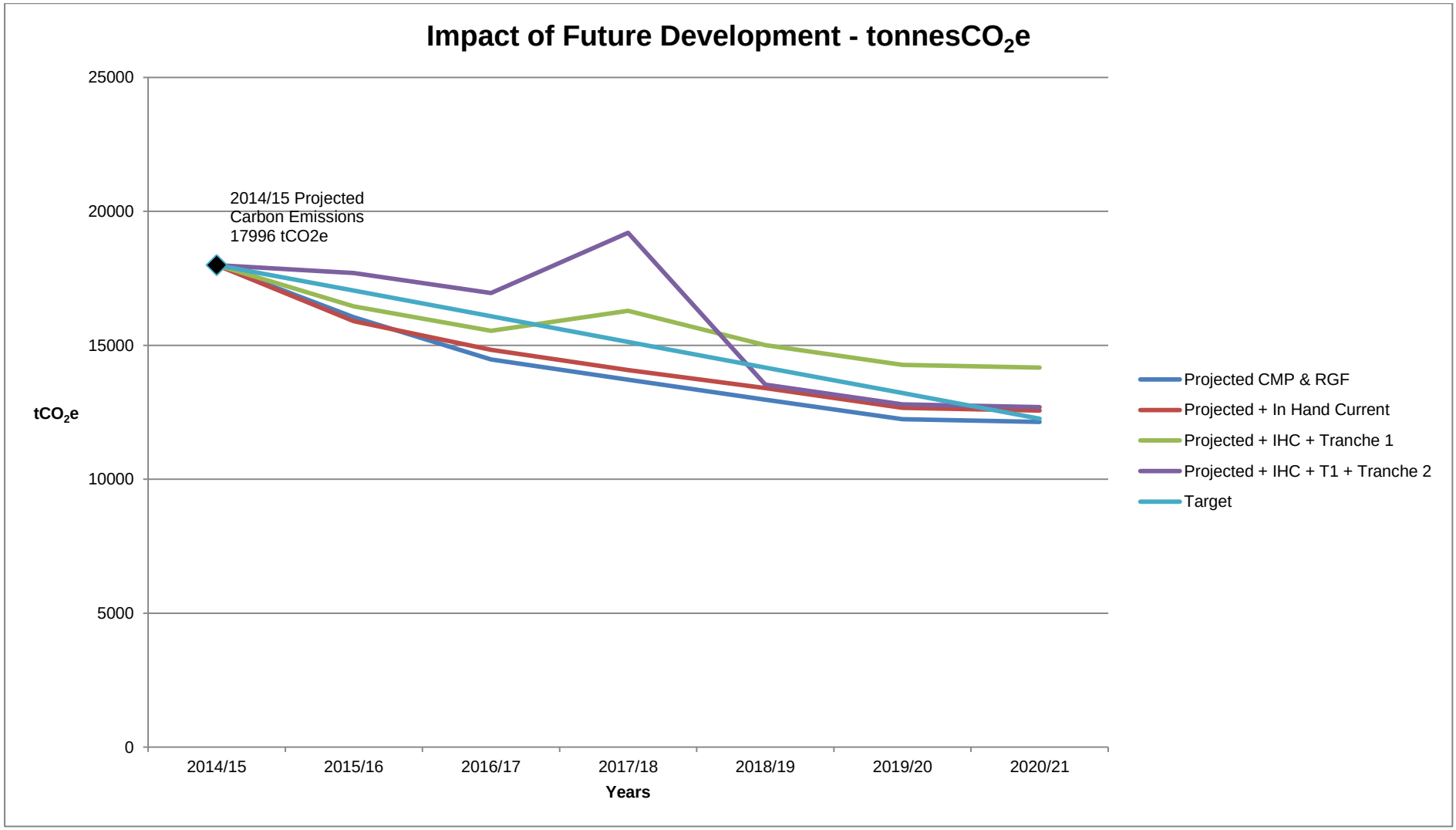
Project	***2015/16***	***2016/17***	***2017/18***	***2018/19***	***2019/20***	***2020/21***
Redevelopment of the Engineering Complex	0	300	1400	-670	0	0
Sport and Wellbeing Centre	0	0	100	0	0	0
AMCC 1 & 2	700	0	0	0	0	0
Demolition of John Crank	0	-650	0	0	0	0
TOTAL Emissions	***700***	***-350***	***1500***	***-670***	***0***	***0***

Tranche 2 Projects (in tCO_2e)

Project	***2015/16***	***2016/17***	***2017/18***	***2018/19***	***2019/20***	***2020/21***
Learning & Teaching Centre	0	0	0	620	0	0
AMCC 3	700	0	0	0	0	0
Residential Accommodation – third party funder	0	0	0	0	0	0
Hamilton Centre Redevelopment	0	0	0	0	0	0
New Energy Centre	0	0	0	-4400	0	0
TOTAL Emissions	***700***	***0***	***0***	***-3780***	***0***	***0***

Future Development Project Totals **(in tCO_2e)**

Project	***2015/16***	***2016/17***	***2017/18***	***2018/19***	***2019/20***	***2020/21***
In Hand Current	-150	510	0	65	0	0
Tranche 1	700	-350	1500	-670	0	0
Tranche 2	700	0	0	-3780	0	0
TOTAL Emissions	***1250***	***160***	***1500***	***-4385***	***0***	***0***



CMP – Carbon Management Plan Projects RGF – Rolling Green Fund Projects IHC – In Hand Current Projects T1 – Tranche 1 Projects Tranche 2 – Tranche 2 Projects

5. Carbon Management Plan Financing

It is recommended that a £100K annual budget be created within the existing Estates Department's budget envelope, dedicated to financing small scale energy conservation measures as and when these are identified. However the larger projects, identified in *Section 4* above, require greater investment and it is anticipated that some of these will be funded through the Stock Condition Works budget and some through budgets allocated to major refurbishment and new build projects. Others will need to be considered on a case by case basis with thorough feasibility proposals and business cases being submitted to senior management for consideration under a bid for capital funds.

It should be recognised that whilst a degree of flexibility is necessary in scheduling the projects in this Carbon Management Plan, those identified have been included because they are likely to be cost effective to implement, efficient and with wider positive benefits to the campus environment. These benefits include operational considerations, aesthetic value, awareness building and enabling other projects to develop. However, all reasonable payback options are given consideration on a case by case basis, wherein the factors to be considered include the wider benefits the project may create, and the ease of implementation by the project team.

Funding is available on an annual basis through the Rolling Green Fund (RGF); it continues to provide financial support as the financial savings gained from the energy efficiency measures already undertaken are returned to the fund until the original project investment is repaid. The recycled money can then be used for further investment.

Renewable energy projects can provide an income stream because of the feed in tariff scheme and the renewable heat incentive, this income could be used to provide funding for other conservation projects.

Other opportunities for external funding will be considered as and when they become available in the coming months and years. Ultimately, it is expected that the Carbon Management Plan will have substantial financial benefits for Brunel and that the listed projects are a sensible investment that will provide an element of mitigation against unexpected eventualities arising in the energy market.

6. Stakeholder Management and Communications

6.1 Stakeholder Management

Brunel has defined Key Stakeholders as those individuals in the organisation who can influence and motivate staff and students within their respective area of responsibility to ensure the programme objectives are successfully delivered.

Those key stakeholders are generally the Environment Sub-Committee and senior members of staff responsible for significant teams and budgets, but may also be individuals with specialist knowledge. The support and commitment of the key stakeholders is critical to the success of the programme.

The members of the implementation team (Estates Projects and Carbon Reduction Action Group) are also key stakeholders, with specific responsibility for delivery of the programme, including:

- Provision of data and expertise relating to sources of emissions for monitoring progress in future years

- Identification of emissions reduction opportunities including project life cycle assessments and conformity with Brunel's financial procedures.
- Contributing to the implementation of the Brunel Energy Policy.
- Delivering the Communication Plan to support the Brunel Environmental Policy, including this Carbon Management Plan, and the evaluation of consequent behavioural change.
- The degree to which the Brunel Environmental Policy, including this Carbon Management Plan, is integrated within Brunel's core activities of teaching and research

6.2 Communicating this Carbon Management Plan

For this Carbon Management Plan to be effective it is essential that all key stakeholders understand its strategic objectives, which are:

- To reduce the consumption of all utilities; electricity, gas and water
- To reduce the environmental impact of emissions associated with the operation of the university
- To reduce the costs associated with the procurement of utilities and disposal of waste
- To understand and quantify the potential to reduce consumption and waste
- To develop a prioritised list of investment opportunities to deliver the savings
- To promote Brunel internally and externally as an organisation that cares about these issues
- To demonstrate to staff, students and the wider community that Brunel has in place a progressive and comprehensive programme to manage its impact upon the environment
- To integrate the objectives of carbon management into the procurement and development of new buildings and refurbishment projects
- To embed the principles of carbon management into the culture of Brunel

To assist in achieving these, a separate Communications Plan is to be developed. This Communication Plan underpins the Brunel Environmental and Energy Policies as well as this Carbon Management Plan. The aim of the Communication Plan is to embed environmental sustainability, including carbon reduction, as a core value within all Brunel's activities, including:

- Teaching
- Research
- Provision of student accommodation
- Services required to support the above

A separate and detailed implementation plan for the Communications Plan is to be devised and will include a development routemap and resourcing plan which will ensure that the Carbon Management Plan fully supports all aspects of the Brunel Environmental and Energy Policies.

In relation to carbon management, the objectives of the Communications Plan are to:

- Give a clear signal to staff and students from the senior management team that Brunel is committed to this issue for the long term
- Establish a clear shared understanding of the Carbon Management Plan's vision and goals
- Generate enthusiasm for carbon management and therefore help the programme secure the necessary resources
- Keep the programme in touch with changing academic, estates, student and other needs
- Enable early recognition of risks and issues so that the programme plans can be adapted where appropriate
- Ensure accurate information and guidance are provided at the right time
- Ensure that decisions are based on accurate information

- Improve readiness for change amongst staff that may be impacted by the carbon management programme, through changes to working practices
- Ensure that staff and students understand their personal responsibility

In support of the Communications Plan it is proposed to develop "Green Brunel" as a corporate brand for Brunel's environmental sustainability programmes, including carbon management and reduction.

At the heart of this new brand lies the proposed "Green Brunel" website (www.Brunel.ac.uk/greenbrunel) which is intended to act as the "landing point" for stakeholders, internal and external, staff and student, seeking information about environmental sustainability at Brunel. The website will have links to academic activities, activities undertaken by the Estates and Operations departments, Union of Brunel Student activities and activities undertaken by Brunel Environment, Sustainability and Transport Group (BEST). "Green Brunel" is planned to be linked to and from the main Brunel homepage (www.Brunel.ac.uk) via the separate Estates Department and Operations Department pages.

The proposed "Green Brunel" brand plays a vital role in promoting the notion that stakeholders bear a personal responsibility in contributing to the success of Brunel's environmental sustainability programmes. For this reason the brand is supported by the strapline *"**your** campus, **your** environment"*.

7. Governance, Ownership and Management

7.1 Governance Structure to Deliver Brunel's Carbon Management Plan

Carbon management and its governance have been incorporated into the Brunel Environmental, Sustainability and Energy Policies which are managed under the following governance structure:

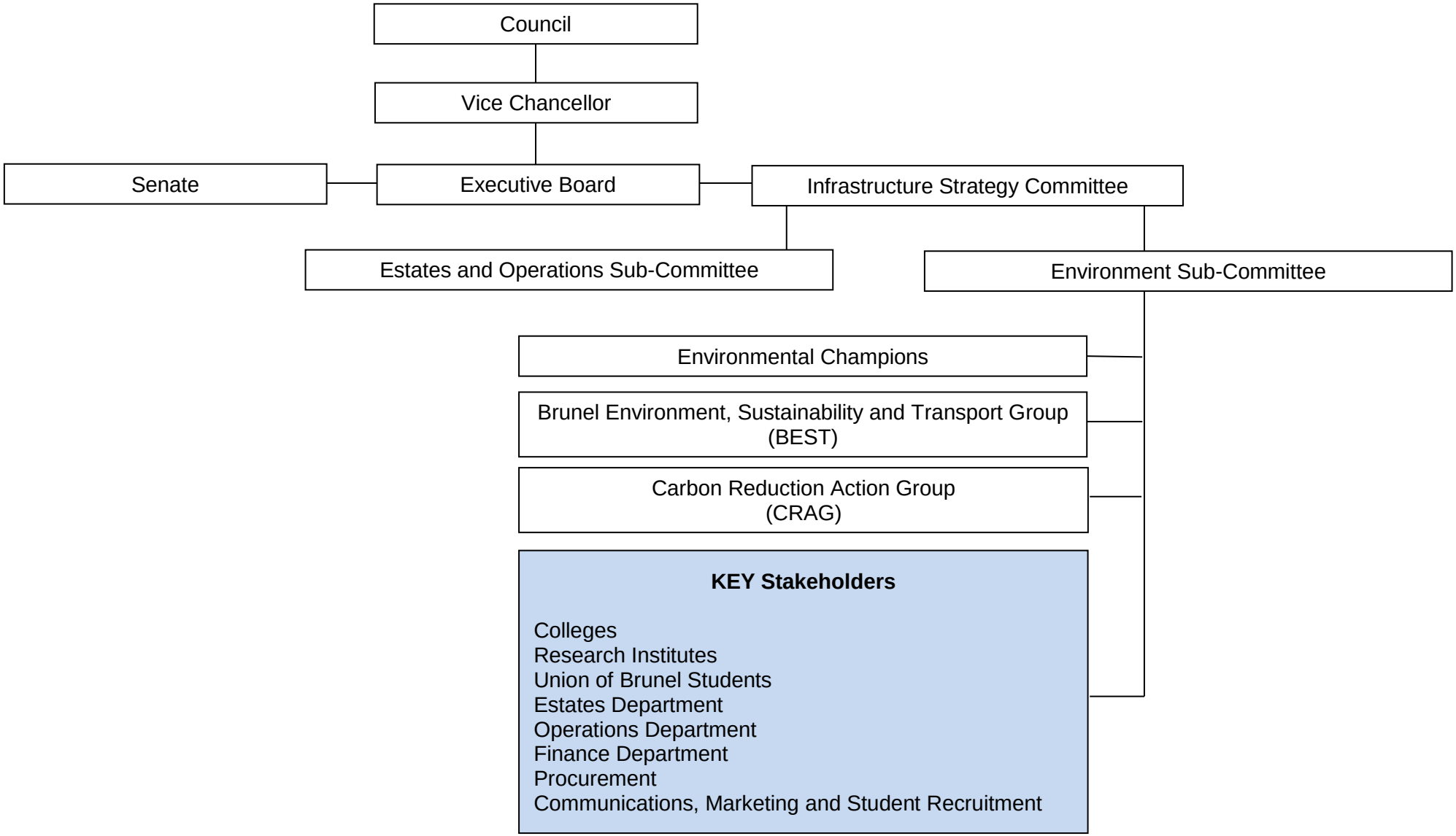
The Environment Sub-Committee has stakeholder representation from the Professional Support Services, Colleges, Institutions, Departments and the Union of Brunel Students. In particular, the Environment Sub-Committee promotes carbon reduction opportunities in:

- New-build and building refurbishment projects
- Planned and reactive maintenance
- Utility management
- Facilities management and waste disposal
- Student accommodation
- Procurement
- Information Systems
- Behavioural and organisational change
- Student engagement and the Union of Brunel Students

Its role includes the implementation of Brunel's environmental sustainability initiatives. It is a permanent sub-committee of the Infrastructure Strategy Committee. Matters requiring wider consultation and approval are reported by the Environment Sub-Committee to the Infrastructure Strategy Committee. Matters which have been approved by the Environment Sub-Committee are tabled for adoption by the Infrastructure Strategy Committee, whose role includes:

- To provide oversight and strategic support to the development and ongoing review of Brunel Environmental Sustainability, Carbon Reduction and this Carbon Management Plan and sign off any amendments or new strategies prior to submission to Council for approval.
- To monitor progress of Carbon Reduction against agreed targets.

Organisational Chart to Manage Carbon Reduction at Brunel University London



Carbon Management Plan Responsibility Table

Responsible Person				
Activity	**Director**	**Lead Manager**	**Core Team Member(s)**	**Others**
Carbon Management Plan Implementation • Set objectives • Manage Implementation Plan • Maintain Opportunities Database • Monitor and review progress against plan • Monitor and Report on Emissions	Director of Estates	Chief Engineer	Energy Sustainability Manager	Assistant Director of Estates –Projects Assistant Director of Estates – Maintenance Union of Brunel Students – President and Environment Chair
Financing of Carbon Management Activities	Director of Estates Director of Finance	Chief Engineer Procurement Manager	Energy Sustainability Manager	
Carbon Management in Buildings	Director of Estates	Assistant Director of Estates – Maintenance	Chief Engineer Assistant Director of Estates – Projects Energy Sustainability Manager Institute and College Services Managers	Estates Department Project Officers Green Champions Union of Brunel Students – President and Environment Chair

Responsible Person				
Activity	**Director**	**Lead Manager**	**Core Team Member(s)**	**Others**
Waste Management	Director of Commercial Services	Deputy Director Commercial Services	Support Services Manager Director(s) of College Operations, Institutes Director of Operations	Residence and Operations Managers Institute and College Services Managers Union of Brunel Students – President and Environment Chair
Communications and Stakeholder Engagement	Director of Estates	Director of Communications, Marketing and Student Recruitment	Chief Engineer Energy Sustainability Manager Health, Safety and Environmental Officer (Science and Environment)	Institute and College Services Managers Green Champions Union of Brunel Students – President and Environment Chair
Purchasing	Director of Finance	Procurement Manager	Director(s) of College Operations & Institutes Director of Operations	Institute and College Services Managers
Residences, Hotel and Conferencing	Director of Commercial Services Director of Accommodation and Residences	Deputy Director Commercial Services Head of Conference, Hotel & Retail Head of Residences	Head of Hotel Retail Manager (Costcutter) Residential Services Manager	Residence and Operations Managers

7.2 Risks and issues management

A summary of the key issues which may impact upon the programme are listed below together with a broad risk assessment.

These issues will be reviewed regularly to ensure the programme is not de-railed or progress delayed. The table below identifies the risks:

Issue	Risk to Project	Probability	Impact	Corrective Action
Institutional Growth	Institutional growth above 0% will reduce the ability to meet the 43% target with growth >3% leading to zero progress	High	High	Institutional plans should restrict growth
Changing face of HE market, international and home based competition	This issue poses no risk to the project merely enhances the need for it to be successful and actively reported on	Low	Medium	Effective Carbon Management will improve efficiency and make Brunel more attractive to all potential customer groups if challenged on environmental probity, able to positively respond
University's financial strength	Lack of capital to invest in the identified carbon abatement opportunities	Medium	High	Re-enforce value at stake calculation Bring forward quick wins Promote Salix funding Re-invest savings
Impact of utility and waste management price increases	Major issue for Brunel, increasing costs may mean less money to invest in projects	High	High	Opportunity to demonstrate the value of carbon management, by offsetting increases against relatively modest reduction in emissions
EU & UK legislation	Brunel will be effected by the introduction of the Carbon Reduction Commitment - Current emission levels will be costly to cover with allowances	High	High	EPBD will introduce energy labelling for some of our buildings. CRC provides a clear signal that inefficiency carries both operational cost and risk to reputation
Carbon management not recognised by Colleges, Departments and Institutions as their responsibility	No incentive to engage with the programme	Medium	Medium	The principle of personal and business centre responsibility must be clearly communicated from the VC

Issue	Risk to Project	Probability	Impact	Corrective Action
'Beat them with a big carrot'	Without a quid pro quo unlikely to motivate the behavioural change necessary	Medium	High	Implement and publicise the Carbon Management Plan. Communicate information on simple methods of introducing good practice in the workplace and devise ways of giving back some of the benefit to the school or department
Brunel vision post Carbon Management Plan launch	Programme regarded as short term, lack of commitment from key stakeholders	Medium	High	Reinforce senior management commitment through communication plan Ensure EnSC has terms of reference linked to UK &international targets for carbon reduction. Clear reporting line with access to resources

7.3 Initiatives and Opportunities
The effective implementation of this Carbon Management Plan is supported by a number of initiatives and opportunities which relate to the governance and management of the plan.

7.3.1 Maintenance Carbon Management Plan
A review is currently underway into the provision of planned and reactive maintenance to the Brunel estate. A number of the projects delivered under the 2010 Carbon Management Plan might best be described as maintenance rather than energy management projects. This leads to the possibility of looking for opportunities for delivering and funding measureable carbon reductions within existing maintenance programmes, particularly the Long Term Maintenance Programme.

7.3.2 Brunel Environment Management
Brunel achieved ISO 14001 in 2012, with the Environmental Management System encompassing the whole campus and all its activities; operational, research and academic related. Energy efficiency and carbon reduction are an integral element in the campus environmental management and as such every opportunity to improve and implement them both will be taken.

7.3.3 Brunel Environment Sustainability and Travel Group (BEST)
BEST was launched in September 2013 aimed primarily at students to encourage them to work towards creating a sustainable and environmentally friendly University through active volunteering and participation in environmental activities and projects. It is hoped that BEST will provide an active channel through which students can support suitable carbon reduction activities along with contributing ideas for future potential projects.

7.3.4 Green Impact Programme
The Green Impact Award programme for Staff was launched in late 2014. By joining the programme it will enable the creation of Green Champions and provide them with a structured activity set which would encourage them to work within their departments to measure current environmental performance and to effect real improvement. It is planned to be engaging and fun for all participants.

Green Impact is an environmental accreditation scheme that encourages pro-environmental behaviours by staff. It empowers Green Champions within their workplace, helping them to gain recognition for their environmental efforts, whilst playing on the competitive spirit of staff working in teams. It provides people and their departments with a tangible framework for improving their environmental performance, breaking down complex environmental issues into bite-size chunks.

7.4 Benefits Management
There will be several indicators to measure both the quantitative and qualitative benefits of the Carbon Management Plan programme.

Firstly, progress of project implementation will be reported to the Environment Sub-Committee and then to the Infrastructure Strategy Committee. Following completion the performance of each project will be closely monitored to establish the exact level of energy and carbon savings achieved. This procedure will ensure that progress on carbon abatement is accurately reported.

Secondly, the benefits of the associated reduced consumption, emissions and cost. Key Performance Indicators derived from and reported annually via the Estate Management Report have been identified that will clearly demonstrate the performance of the estate. These will allow internal and external benchmarking and will enable the comparison of year on year performance. Relating to environmental sustainability these include:

1. Energy consumption per m^2 nett internal area (NIA)
2. Energy consumption per m^2 NIA per building

3. Energy consumption per student bedroom
4. Energy consumption per student and staff FTE
5. Mains water consumption per m^2 NIA
6. Mains water consumption per m^2 NIA per building
7. Mains water consumption per residential student
8. Mains water consumption per student and staff FTE
9. CO_2e emissions (Scope 1, 2 & 3 via EMR)
10. Customer opinion on Brunel's environmental sustainability performance
11. People and Planet Green League ranking

7.5 Reporting and Evaluation

During the years following the formal adoption of the Carbon Management Plan in which carbon reduction projects will be put into operation, there will be regular updates on the programme targets and evaluation of the programme status. This will:-

- Ensure that carbon management is being implemented effectively
- Enable management to be improved and optimised where appropriate
- Provide data that can be used to update the emissions targets and programme scheduling

The Carbon Reduction Action Group will have responsibility for delivery of the actions identified in the programme and monitoring progress.

The Environment Sub-Committee will be kept appraised of developments in the programme at regular intervals.

The Infrastructure Strategy Committee will receive an annual report covering the status of the programme at the end of the academic year.

Appendix 1

Energy Policy

This Energy Policy sets out how the University will manage energy use in a sustainable manner. Thereby making a significant contribution to its own, Higher Education Funding Council for England (HEFCE), government and global carbon reduction goals and controlling a major operating cost.

Introduction
The Energy Policy has been developed with reference to the Carbon Management Plan. It also meets the objective of the University's Vision: *"to be a world-class creative community that is inspired to work, think and learn together to meet the challenges of the future"*. It will contribute directly to the aims of the University's Environmental Policy.

The anticipated benefits include:

- an improved environmental performance through a reduction in carbon emissions
- realisation of recurrent cost savings
- compliance with existing and future environmental legislation
- an improved reputation for the University

Purpose and Scope
This Energy Policy sets out how the University will manage energy use in a sustainable manner. Thereby making a significant contribution to its own, HEFCE, government and global carbon reduction goals and controlling a major operating cost.

The Energy Policy applies to all energy use on University premises.

Target
Brunel University London will reduce the Scope 1 and 2 CO_2e emissions from its activities by 43% by 2020/21, compared to its 2005/06 baseline.

Strategic Objectives

1. Monitoring and targeting

- To develop an integrated whole campus energy metering, sub metering and reporting framework.
- To set and review short-term targets for energy use and carbon emissions, by building and department, prioritising those areas where significant savings can be made.

Specific measures: *Identify which buildings use the most energy, install automatic metering and set monthly targets for reducing energy use. Provide regular reports for College, Institution, Departmental and Building Managers and via the intranet.*

2. Energy costs

- To procure electricity and fuels at best available rates.
- To facilitate investment in energy saving measures with short paybacks.
- To source external funding for renewable energy and low carbon projects.

Specific measures: *Review and compare energy costs on a monthly basis. Find funding to invest in projects with less than a 10 year payback. Seek grant funding for renewable energy and low carbon technologies.*

3. Energy awareness and promotion

- To encourage better use of energy and the need to reduce emissions to all staff and students.
- To promote the University's commitment to saving energy and carbon.

Specific measures: *Introduce a Code of Practice for Energy detailing how energy should be most efficiently used. Support the ongoing implementation of the University's Space Temperature Policy especially the guidance on set points for heating and cooling. Maintain energy and carbon saving web pages on the Intranet and web site and promote energy and carbon saving initiatives through internal and external publications.*

4. Legislation

- To prepare for Government and other institutional targets, policies and legislation and where possible to anticipate and exceed requirements.

Specific measures: *Ensure the University complies with the Energy Performance of Buildings Directive and associated legislation such as the requirement for Display Energy Certificates. Maintain on an ongoing basis the University's participation in Phase 2 of the Carbon Reduction Commitment.*

5. Organisation

- To further emissions reduction aims through the Carbon Reduction Action Group and also existing working groups and committees, and to enter into new partnerships within and outside the University where this is beneficial.

Specific measures: *Implement the Carbon Management Plan through the Carbon Reduction Action Group. Work with existing working groups and committees in the University such as the Infrastructure Strategy Committee and its Environment Sub-Committee. Work with other universities and other organisations to share best practice.*

6. Other policies

- To review and revise existing University policies in order to pursue the need to reduce energy consumption and carbon emissions. Procurement of new equipment and buildings should be based on whole life costing and environmental impacts.

Specific measures: *Review current IT, procurement and other polices through the Carbon Reduction Action Group and Environment Sub-Committee which impinge on energy use and carbon emission. Highlight opportunities for improvement. Also identify gaps in policy which could affect energy use. Provide information on whole life costs and the cost of carbon emissions.*

Responsibilities

Carbon Reduction Action Group

- To oversee the development and implementation of the University's Carbon Management Strategy.

Energy Sustainability Manager

- Reporting to the Chief Engineer.
- To oversee the management of energy across the University and ensure that the specific measures set out in this Energy Policy are adhered to.
- Create and maintain a high profile for energy management to develop a positive image of the University.
- Develop and publish guidance based on this energy policy.
- Publish and regularly review this energy policy.

- To develop the University's Carbon Management Plan from a strategic vision into an operational plan that delivers the objectives and targets set out in the approved document.
- To promote staff and student awareness about using energy more efficiently.
- To communicate energy savings success stories.

Estates Project Team

- To implement projects to reduce energy use.
- To increase staff and student awareness and motivate building users to use energy more efficiently.
- To work in partnership with the Energy Sustainability Manager to implement this energy policy.

College, Institution, Departmental and Building Managers

- To increase staff and student awareness and motivate building users to use energy more efficiently.

Staff and Students

- To reduce energy use and to make efficient use of energy at all times.
- To be aware of the energy use in the buildings and facilities they use on campus.

October 2014

Appendix 2

Environmental Policy

Brunel University London is firmly committed to enhancing its environmental management and performance through its strategies, policies, risk management, and procedures. 'Sustainability' is one of the core values of the University, and the University's Strategic Plan 2013 to 2017 obliges the University to provide 'an enabling environment' where teaching and research, campus infrastructure, facilities, and general activities are managed, developed and monitored in an environment-responsible and sustainable manner.

The University acknowledges it is responsible for continually improving its environmental performance, preventing pollution and protecting the environment at all levels.
The University will set targets and action plans to meet the following objectives:

Environmental Management and Legislative Compliance

- Having achieved maintain the internationally recognised Environmental Management System (EMS) ISO14001:2004
- Meet, and wherever possible, apply more stringent standards to ensure the University's compliance with relevant environmental legislative and other requirements

Academic Life

- Engage with the academic community to integrate the theme of sustainability into teaching and research

Reduce Environmental Impacts

- Enhance the University's carbon management and continue to reduce its carbon emissions
- Improve energy and water management by reducing their consumption
- Implement the waste hierarchy to minimise waste through elimination, reduction, reuse and recycling
- Implement the Travel Plan and promote sustainable modes of transport to and from the University
- Enhance biodiversity and maintain the grounds and buildings in a sustainable manner
- Promote sustainable procurement activities and Fairtrade
- Enhance energy efficiency in the estate and buildings by undertaking necessary refurbishment work and by minimising adverse impact

Communication, Awareness Raising and Involvement

- Establish and maintain a communication channel with all staff and students
- Promote and raise awareness of good environmental policies and practices with staff, students and other stakeholders across the University

As part of the University's EMS, the University will actively communicate information, both internally and externally, regarding its environmental objectives and targets.

October 2014

Appendix 3

Space Temperature Policy

1. Objective

This document seeks to clarify the position regarding internal space temperature limits that occupants may be exposed to and highlights relevant legislation. It is important that staff and students are made aware of this policy. The policy should be made reference to (web-link or hard copy) to all current staff and students as well as potential new joiners.

The responsibility here lies with;

- Student Services for Students
- Human Resources for Staff

2. Background

The University is aware that in some instances, space temperatures in various areas of its buildings can become uncomfortable for some occupants. However, this also has to be balanced against the University's energy use and the environmental consequences that artificially conditioning spaces can create. Energy costs are rising significantly and have doubled in the last 3 years. There is also widespread concern relating to global warming, climate change and sustainability. The University campus electricity bill is now over £2.7M (2013/14) and rising. The University campus gas bill is now over £1.5M (2013/14) and rising. This incurs the release of approximately 22,000 tonnes of CO2.

Furthermore, HEFCE have introduced a strategy for carbon reduction in Higher Education. In which there is a link between carbon reduction performance and capital funding.

Following HEFCE's commitment to the Government's target, our Carbon Management Plan sets two milestones – 20% and 35% reductions in 2012/13 and 2017/18 respectively – in order to meet the target of the 43% reduction in 2020/21

We aim to make Annual Reductions of 3% year on year from 2005/06 baseline for both Gas, Electricity & Water.

The University feels that it is appropriate to produce a policy so building users know what to expect and why there are limitations as to what can be achieved. An energy management programme is incorporated in the Carbon Management Plan addressing the high energy use particularly with regard to electricity. It should be noted that it is the responsibility of local managers for the welfare of their staff and therefore issues regarding space temperatures should be routed through them in order for the appropriate action to be taken.

3. Space Temperature Limits

Whilst there is legislation regarding heating energy for both minimum and maximum temperatures, there is currently no maximum temperature limit for summertime cooling. The Health and Safety Executive (HSE) has stated that it is inappropriate to set and enforce a maximum working temperature because thermal comfort cannot be determined by air temperature alone. The HSE considers 80% of occupants as a reasonable limit for the minimum number of people who should be thermally comfortable in an environment and a risk assessment should be carried out to include thermal comfort if this cannot be met.

Thermal comfort cannot be easily defined as it depends on a range of environmental and personal factors and perceptions. The British Standard BSEN ISO 7730 defines it as: 'that condition of mind which expresses satisfaction with the thermal environment'.

Heating

The Workplace (Health, Safety and Welfare) Regulations 1992 and the associated code of practice states that: 'During working hours a reasonable internal temperature must be maintained and this must not be less than 16°C unless the work involves severe physical effort in which case the temperature can be lowered to no less than 13°C. On the 1st October 1980, the then Department of Energy introduced an order to reduce the maximum heating limits from 20°C to 19°C in order to save energy. There are exceptions to this under certain circumstances and they do not apply to living accommodation.

Additionally, the Fuel and Electricity (Heating) (Control) (NI) Order 1975, as amended, prohibits the use of fuel or electricity to raise the temperature of a building above 19°C, which, taking account of the above incidental heat gains, will generally provide a comfortable working environment.

Heating Policy

The University will endeavour to maintain an optimum working time space temperatures of 19 °C in all its non-residential buildings with the exception of areas not used as office accommodation or teaching space (i.e. corridors, workshops, plant rooms, staircases etc.). The minimum maintained temperature for all work spaces will be no less than the statutory minimum as detailed above.

- For the majority of buildings, working hours are deemed to be 8:45am to 5:30pm Monday to Friday. Outside these times, the heating will be 'set-back' to background conditions of 14°C.

- Residential buildings will be maintained at a minimum of 19°C during periods of occupation **in the day (8:30 am to 23:00) with a temperature set back of 14°C during the night** to reduce energy consumption and improve sleeping conditions.

- The heating season although generally runs from October to April is not date related but is determined by external weather conditions, with the final decision resting with the Chief Operating Officer.

- During University shutdowns heating in some areas may be set to 14°C on a 24 hour basis

- For the majority of cases, the University is unable to heat specific offices or floors outside normal operating hours although some areas may have a set-back temperature.

- Portable electric heaters and fires may not be used unless:
    - Consent has been given by the Estates Department and guidance issued by the Health and Safety Department regarding type (oil filled not convector) and PAT testing is followed.

University owned portable heaters will be removed from the area in which they are being used if they are deemed to be raising the temperature of that space above the parameters dictated in this policy or affecting the main heating sensors and turning off the heating to the wider area. Individuals contravening the above will be issued with a notice asking them to remove the heater either because it is unsafe i.e. not PAT tested or because it is consuming excess energy.

There are limitations with some of the University's heating systems due to their age and layout which may mean that it is not possible to meet the above criteria in some circumstances. In this case alternative means will be investigated and implemented where viable.

How We Manage your Heating

To ensure your comfort and to meet our environmental responsibilities to reduce energy consumption and thus CO_2e emissions the University continues to invest in and install intelligent building management systems (BMS) to its buildings.

These BMS systems have at their core a programmable mini-computer which enables "intelligent" control of building plant and sub-systems such as heating, hot water and ventilation.

The BMS is intelligent in that we are able to programme a set of control parameters for building operation such as the ideal room temperature, hot water temperature etc. The systems will then work to try to achieve these environmental conditions.

We set these against UK standards and accepted best practice for achieving the ideal comfort and operational conditions for the varying types of buildings on campus.

The majority of our heating systems are managed as Variable Temperature systems, this means the amount of heat put into the building and thus coming from your radiators varies in relation to the outside temperature.

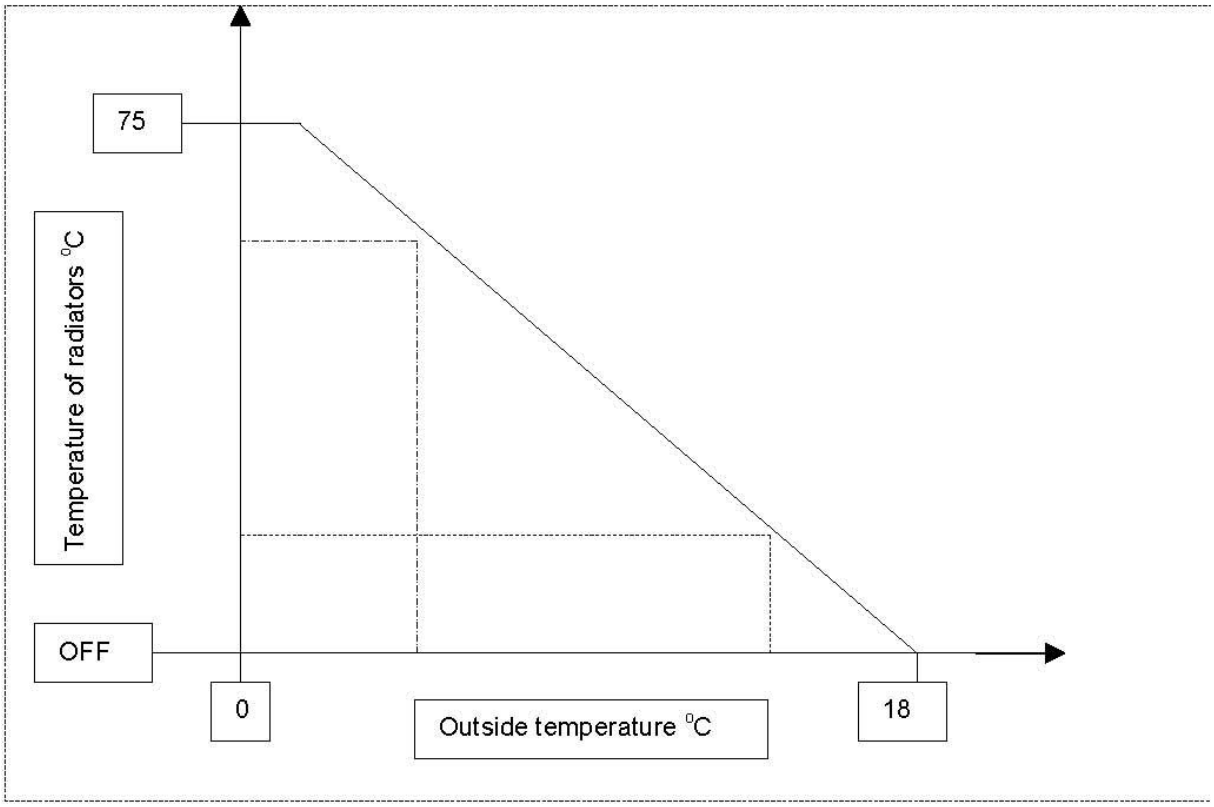
This is set up as a simple straight line relationship illustrated by the diagram below.

Some radiators also have individual thermostatic radiator valves (TRV) which provide local control and a pilot scheme is underway in several residential accommodation halls with programmable TRV's linked to motion sensors to provide closer control and to reduce the heating of unoccupied rooms.

Automatic Doors

All new installations of automatic doors should include the facility of a push plate to allow the doors to be switched to a semi manual mode in periods of cold weather to prevent unnecessary opening of the doors due to the sensors being triggered by passing pedestrians.

The above should be considered during refurbishment and upgrade programmes.



The diagram shows simply that the warmer it is externally the “cooler” the radiator temperature will be and vice versa. At an outside temperature of 18°C the system will shut itself ‘off’.

In typical circumstances with an outside temperature of 14°C the temperature of your radiator will be approximately 40°C. This is only 3°C above body temperature so it will be difficult to feel any warmth from the radiator at all, but it does not mean the system is not working.

At a lower outside temperature say 0°C the temperature of your radiator will be set at approximately 75°C. This is twice your body temperature and therefore will be hot to the touch.

In the majority of our buildings we aim to maintain an internal space temperature of 19°C throughout the core areas during normal working hours.

Intelligent building management systems allow us to better maintain comfort conditions for the occupants based on both internal and external influences whilst also only consuming the energy to meet that demand and avoid unnecessary wastage.

Cooling

Air conditioned spaces use around twice as much energy as naturally ventilated areas and tend to generate more user complaints. In addition, because of the cycle of the academic year, many parts of the buildings are unoccupied over the summer period when peak temperatures occur more frequently so low energy solutions may be more appropriate. Suggested summertime peak design temperatures are 23±3°C for a formal office. These are for guidance only.

Cooling Policy

As a general rule the University will not fund the installation and running costs of air conditioning systems unless they are required:

- By regulation or enforceable code of practice,
- By specific items of equipment such as server rooms,

- Because natural ventilation is insufficient to remove heat gains and/or provide the necessary changes of air
- Because occupants and/or equipment consistently raise the ambient temperature to above 28°C for a minimum period of two hours for three days of a five day working week.
- Air conditioning will not be installed in any residential building with the exception of office areas in such buildings, providing they meet the installation criteria.

Where areas are overheating, a thorough appraisal should be carried out to ensure that all alternative options have been considered before air conditioning is installed. These will include:

- Ensuring any heating is not operating in the area and any hot pipes are insulated
- Providing window blinds and/or desk or ceiling fans
- The installation of window film and/or solar shading devices
- Management of the use of heat producing equipment to reduce heat gains (lighting, office equipment and refrigeration)

The use of mechanical ventilation is preferred to full air conditioning. If it is deemed that cooling requires to be installed then the users and the Estates/Operations Departments will need to agree on the cooling strategy before detailed design begins. All installed cooling equipment should:

- Be as energy efficient as possible,
- Interface with the building energy management system, and
- Contain refrigerant gases that have zero ozone depletion potential.

Where air conditioning is already installed, the space temperature should be set no lower than 23°C and the system set to provide cooling only when the space is occupied. All doors and windows of the conditioned space should remain closed and no portable heaters should be in operation to warm up an overcooled space.

Portable air conditioning units are not permitted for use in University buildings unless they are installed with a permanent extract duct. Desk fans with a maximum electrical power consumption of 100 W may be used providing that they have been PAT tested.

Special Circumstances

The University is sympathetic to international students and people with disabilities and is prepared to consider temporary individual specific requirements outside the scope of this policy.

How you can help to save energy

There are several measures that staff and students can take to limit the extremes of temperature and help to save energy.

- Dress appropriately for the weather
- Drink hot or cold drinks depending on the conditions
- Use windows appropriately
- Make use of window blinds and curtains in hot weather to reduce solar gain
- Make use of flexible work times where appropriate to avoid extremes of temperature
- Look to work in areas that are already air conditioned but are not being used through hot desking if possible
- Take regular breaks
- Site workstations away from heat or cold sources
- Switch off unnecessary electrical equipment and lighting particularly in summer as these can contribute significantly to heat gains.

October 2014

Appendix 4

WATER MANAGEMENT POLICY

OBJECTIVES

The main aim of the Water Management Policy is to establish procedures and recommended actions to enable Brunel University London to use conserve and discharge water as responsibly and sustainably as possible.

The policy of the University is to control water consumption in order to:

- Avoid unnecessary expenditure on water and drainage
- Improve cost-effectiveness
- Reduce our carbon emissions from water usage in line with national, sector-wide and institutional targets
- Protect the environment

In order to meet the above criteria, a number of objectives have been set:

- Target a reduction of water consumption and associated carbon emissions in line with the figures as set out in the University's Carbon Management Plan
- Utilise water from sustainable sources where practicable, including incorporation of renewable technologies into building development projects
- Invest in projects and equipment to reduce water usage across the University
- Raise awareness amongst staff and students of the important contribution each member can make to water conservation
- Ensure that commitment is obtained from staff at all levels within the University on aspects of water efficiency under their control, i.e., replacing "water to waste" cooling with closed loop cooling systems

The impact of climate change and rising demand for water are putting increasing pressure on our water resources. Water also uses electricity to treat, pump and heat it, so saving water can save energy thereby contributing to carbon management.

The parallel purpose of this policy is therefore to educate staff and students about all aspects of water i.e., consumption, waste and drainage, and raise awareness of how individuals can conserve water on campus through easily implementable actions as listed below:

- Don't leave tap running whilst cleaning your teeth or washing vegetables
- Take a shower – usually as they use 2 – 3 times less water than a bath
- Use a bowl in the sink and be aware of what can/cannot be emptied
- Keep bottles of water in the fridge for making cold drinks
- Report dripping taps as soon as possible

A variety of problems including underground leakages, estimated readings and a lack of water meters have resulted in inadequate data for monitoring and targeting purposes and accurate annual comparisons. This should be addressed by the Automated Metering Monitoring and Targeting system currently being installed in the University.

October 2014