working with

University of Bath
Carbon Management Programme

Carbon Management Plan (CMP)

Date: ***March 2011***

Version number: ***Final, approved by Council, March 2011***

Contents

Glossary

BAU	Business as Usual
BERR	(Department for) Business, Enterprise and Regulatory Reform
BITC	Business in the Community
BMS	Building Management System
BREEAM	Building Research Establishment Environmental Assessment Method
CHP	Combined Heat and Power
CCL	Climate Change Levy
CHP	Combined Heat and Power
CIF2	Capital Investment Framework 2
CMB	Carbon Management Board
CMP	Carbon Management Plan
CRC	Carbon Reduction Commitment
CT	Carbon Trust
DBERR	formerly DTI (see above, BERR)
DEC	Display Energy Certificate
DECC	Department of Energy and Climate Change
DEFRA	Department for Environment, Food and Rural Affairs
DH	District Heating
DTI	Department of Trade and Industry
EAUC	Environmental Association for Universities and Colleges
EEAS	Energy Efficiency Accreditation Scheme
FITs	Feed-in Tariffs
GTBS	Green Tourism Business Scheme
HE	Higher Education
HEFCE	Higher Education Funding Council for England
HEI	Higher Education Institute
IRR	Internal rate of return
kWh	Kilowatt hour
kWp	Kilowatt peak
NPV	Net present value
PIT	Project Implementation Team
RHI	Renewable Heat Incentive
RICS	Royal Institute of Chartered Surveyors
ROCs	Renewable Obligation Certificates
STV	Sports Training Village
tCO_2	Tonnes Carbon Dioxide (taken to mean greenhouse gas emissions or tCO_2 equivalent)
UUK	Universities UK
VaS	Value at Stake
VAV	Variable Air Volume

Vice-Chancellor's introduction to Carbon Management Plan

Our Mission is to deliver world class research and teaching, educating our graduates to become future leaders and innovators, and benefiting the wider population through our research, enterprise and influence. Our research ethos has a strong focus on impact, tackling challenges of global significance, including sustainability. However, we see sustainability as a local challenge to be addressed practically as well as a global one to be addressed theoretically.

Our Corporate Plan 2009/10 - 2013/14, commits us to the "ongoing development and enhancement of our physical infrastructure and specialist facilities to increase capacity, **sustainability** and quality". Our overarching Environmental Policy demonstrates how we intend to increase sustainability by promoting effective environmental management. We are seeking to improve our environmental performance in a number of areas:

- Energy
- Water
- Transport
- Waste reduction and recycling
- Procurement
- Landscape management
- Biodiversity

Our new Carbon Management Plan outlines the types of projects that we will be implementing over the coming years in order to make significant reductions in our carbon emissions. Its implementation will make a major contribution to the goals we have set ourselves in a number of the aspects of environmental performance outlined above.

I would like to thank the Carbon Trust for its invaluable contribution to the development of this Plan. We have had a longstanding relationship with them, being the first University to take part in the Carbon Trust Higher Education Carbon Management Scheme in 2003. We were in the vanguard of the Higher Education sector's engagement with the carbon reduction agenda and it is our ambition to be recognised as an exemplar of best practice in the future.

I am pleased to give my full support to this Plan.

Professor Glynis Breakwell
Vice-Chancellor

Foreword from the Carbon Trust

Cutting carbon emissions as part of the fight against climate change should be a key priority for Universities and Colleges - it's all about getting your own house in order and leading by example. The UK government has identified the Higher Education sector as key to delivering carbon reduction across the UK in line with the Climate Change Act targets, and the HE Carbon Management programme is designed in response to this. It assists Higher Education institutions in saving money on energy and putting it to better use elsewhere, whilst making a positive contribution to the environment by lowering carbon emissions.

The University of Bath partnered with the Carbon Trust on this ambitious programme in 2010 in order to realise substantial carbon and cost savings. This Carbon Management Plan commits the University to a target of reducing CO_2 by 19% by 2014 and underpins potential financial savings to the institution of around £3.9 million by that date.

There are those that can and those that do. Universities can contribute significantly to reducing CO_2 emissions. The Carbon Trust is very proud to support the University of Bath in their ongoing implementation of carbon management.

Richard Rugg
Head of Public Sector, Carbon

Management Summary

Background

A great deal of work on Carbon Management and energy-saving has taken place in the University over recent years. We were the very first University to take part in the Carbon Trust Higher Education Carbon Management Scheme in 2003, we recently achieved a target to reduce our carbon emissions by 12.5% per m^2 building floor area, and we have already achieved £0.5m of annual savings from our electricity consumption compared to 4 years ago.

An ever-evolving situation, however, has led to a new approach being required. The issue of climate change and an organisation's responsibility to reduce carbon emissions is seen as more pressing than ever. The expectations of our students, staff and external stakeholders for our organisation to be incorporating sustainability in its key aims are increasing. The Climate Change Act (2008) has set targets for the UK, and these are being implemented in the HE sector via challenging targets set by HEFCE. The financial and legal context has also changed with an even stronger imperative to save energy and carbon. There was also seen to be a need to revisit the previous Carbon Trust process which was then in its infancy, and to build on its work; this document is the key output from that process.

Our carbon footprint

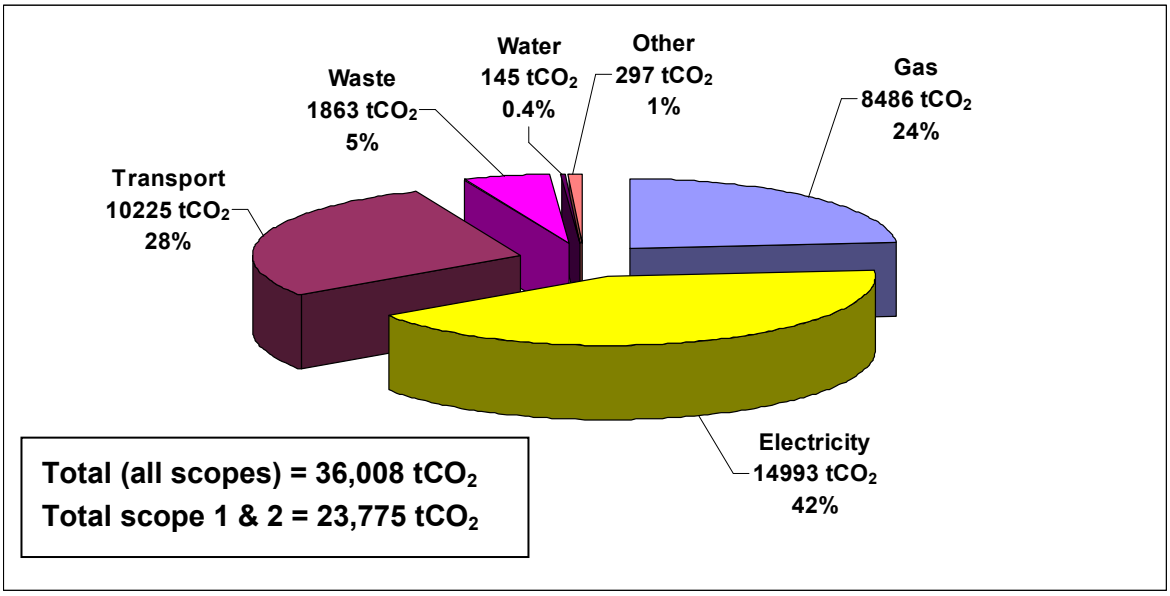

Figure 1 – University emissions by source in 2008/9

Note

The following is the internationally recognised method of classifying emissions categories as defined by the World Business Council for Sustainable Development (WBCSD):

- ***Scope 1*** *emissions - from sources that are owned or controlled by the institution, such as heating plant and vehicles.*
- ***Scope 2*** *emissions - from the generation of purchased electricity consumed by the institution.*
- ***Scope 3*** *emissions - all other indirect emissions that are a consequence of the activities of the organisation and include commuting by staff/students, international travel, water use, waste production, and the purchase of goods and services.*

Our target
We have set an aspirational target in line with national targets and the resultant HE sector target as set by HEFCE.

The University of Bath will aim to reduce the Scope 1 and 2 CO_2 emissions from its activities by 43% by 2020 from a 2005 baseline. We have already achieved a 9% reduction, despite growth in the campus.

We have modelled a future trajectory towards the 2020 target and have set an interim 5 year target, using a more recent year as a baseline (2008/09).

Our intermediate target is to reduce emissions by 19% by 2014/15 against a 2008/9 baseline – this document sets out an action plan to reach this target

The milestone equates to a reduction of 4,600 tCO_2 on a baseline of 23,775 tCO_2. We have included in the modelling any known or likely increases in emissions due to new buildings and other factors – this growth is likely to be around 7% by 2015, clearly making any absolute reductions in emissions even more challenging – a saving of 25% (6,300 tCO_2) will actually be necessary.

In line with guidance, given the difficulties in accurately measuring and monitoring some Scope 3 emissions we have initially set a Scope 1 and 2 target only. The means to measure these emissions are being improved and it is intended that a Scope 3 target and a more detailed plan to achieve these will be developed in the next 2 years. This plan and its financing, therefore, deals primarily with Scope 1 and 2 emissions.

Projects
We have identified a project portfolio capable of delivering 111% of our interim target even when allowing for the expected growth. A key part of this approach will be the major investment planned for the central district heating scheme and Combined Heat & Power (CHP) plant which will deliver a large proportion of the initial savings, but over 50 other specific technical and non-technical projects have also been identified. We will select projects from within the portfolio to achieve our interim target, allowing some margin of safety, and prioritising projects that make financial good sense. This also allows a more realistic probability of achieving the longer term 2020 target.

Much work has already been done to reduce Scope 3 emissions (eg. we have made good reductions in water use, we have clear plans to improve waste performance, and we have had a travel plan for a number of years) and this is highlighted in this report. This action plan and its financing are however focussed on Scope 1 and 2 emissions.

Finances
To implement these projects we will need an investment of £6.5m over the 5 year period of this plan; this is in addition to the investment that the University makes via its major capital projects and maintenance.

The financial value at stake for this programme as compared with a 'Business as Usual' model is £3.9m over the plan period to 2014/15. If this plan is achieved the annual savings compared to now will be £1.26m.The overall payback of the investment is 5.4 years, the NPV £1.64m, and the Internal Rate of Return 10.8%.

This strategy stands up well based purely on financial criteria, even without taking into account any of the other significant drivers. There are a number of risks associated with this plan, and some assessment of these has been included in this document. We have taken a conservative view on costs, savings, and, particularly, future energy prices, and so would expect the financial case to be even better in reality.

Strategy
A Carbon Management Board (which will evolve into a Sustainability and Carbon Management Steering Group) chaired by the Deputy Vice-Chancellor will oversee implementation and further development of the plan. The plan also includes other specific strategies to achieve a low-carbon vision and to embed this in the management of the University.

1 Introduction

The University of Bath is set in an attractive campus at Claverton Down about a mile from the centre of Bath. It currently has 14000 students of whom 3300 live in the student residences both on campus and in the City, and employs 2700 staff. The University is housed in buildings totalling 200,000 m^2 floor area on a 200 acre hilltop site.

It consistently ranks highly in the league tables of UK universities published by a number of national newspapers. Its research is internationally respected, and its students are in demand by employers because of the high quality of the teaching offered here. The University has had close connections with industry and the public and voluntary sectors since its inception in 1966. The research strengths are in engineering, physical sciences, management, humanities, social sciences, health and life sciences with a large research base, and hence it has a large number of energy-intensive facilities. Its sports facilities include a world class £35 million Sports Training Village (STV) facility.

A great deal of work on Carbon Management and energy-saving has taken place in the University over the previous few years. We were the very first University to take part in the Carbon Trust Higher Education Carbon Management Scheme in 2003, we recently achieved a target to reduce our carbon emissions by 12.5% per m^2 building floor area, and we have already achieved £0.5m of annual savings from our electricity consumption compared to 4 years ago with 1,360 tCO_2 saved annually. Allowing for new buildings commissioned during this period, the actual reduction is around 15% or 2,185 tonnes CO_2 saved. We have had a commitment to build BREEAM 'Excellent' buildings for a number of years, and have 3 buildings on site that meet this eco-design standard.

Further evidence of our commitment includes:

- Signatory to the UUK's statement of intent on sustainable development;
- Accreditation under the Carbon Trust Standard, achieved in 2010;
- Accreditation under the Energy Efficiency Accreditation Scheme (EEAS), achieved since 2000;
- Participation in the Revolving Green Fund with a £250k allocation;
- Participation in 'Our Big Energy Challenge', a Bath-area awareness-raising project (http://www.bath.ac.uk/estates/energy/OurBigEnergyChallinks.htm);
- Participation in Universities That Count, with 'Outstanding' scores in the Climate Change and Design & Build sections;
- Implementation of CHP (Combined Heat & Power) schemes, commencing in 1997;
- Setting high standards for design using BREEAM - recently achieving 'Excellent' for our latest student residences, the 4 West building and East building. The residences were Highly Commended for Sustainability in the RICS South West awards. 4 West is the first UK building to use the German, Kiefer concrete-cool passive ventilation system;
- Running a successful, annual energy-saving competition in student residences for the last 4 years. Over 800,000kWh has been saved, with one residence reducing electricity usage by 27% in a single year;
- Deployment of renewables. We have 6 solar hot water systems installed, and our latest major build project will have a 24 kWp solar PV system. We have been working with Partnership for Renewables to investigate wind energy, and have developed proposals for biomass in 2 buildings and a large biomass CHP;
- Continuously making technical enhancements, improving lighting, installing energy efficient boilers, installing water-saving devices, and updating controls;
- Installation of 800 utility meters, including over 500 on our automated monitoring system, creating one of the sector's most extensive data networks.

Our academic research also includes many key areas that will contribute to finding the solutions to climate change issues. Our teaching of the leaders of the future also clearly can have a massive positive impact.

An ever-evolving situation, however, has led to a new approach being required. The issue of climate change and any organisation's responsibility to reduce carbon emissions is seen as more pressing than ever. The expectations of our students, staff and external stakeholders for our organisation to be incorporating sustainability in its key aims are increasing. The Climate Change Act (2008) has set emissions reduction targets for the UK, and these are being implemented in the HE sector via challenging targets set by HEFCE. There was also seen to be a need to revisit the previous Carbon Trust process from 2003 which was then in its infancy, and to build on this work as the original process has been improved and updated. This document is the key output from this process.

The purpose of this Plan is to set out a road map for the next 5 years of how the University intends to achieve its own internal targets, covering technical projects, policy changes and the financing to make it happen.

The Carbon Management process follows these 5 basic steps; steps 1 to 4 were undertaken over the period May 2010 to Feb 2011:

Figure 2 - CMP Process

This plan has been put together by the Energy & Environment Manager with the input of the Carbon Management Team and many other colleagues, under the supervision of the new Carbon Management Board chaired by the Deputy Vice-Chancellor, and with the support of consultants employed by the Carbon Trust.

2 Carbon Management Strategy

2.1 Context and drivers for Carbon Management

The issue of climate change and any organisation's responsibility to reduce carbon emissions is more pressing than ever. Climate change is a potential threat to the economy and the environment; the natural cycles that support our very existence are potentially at risk. The Stern Report highlighted that the costs of inaction far outweighed the cost of action. The expectations of our students, staff and external stakeholders for our organisation to be incorporating sustainability in its key aims are increasing. Below is a summary of the context and drivers for the University.

2.1.1 Legal Drivers

The Climate Change Act (2008) has set targets for the UK, and these are being implemented in the HE sector via challenging targets set by HEFCE, our funding body. The current round of capital funding allocation from HEFCE (Capital Investment Framework - CIF2) is directly linked to Carbon: to qualify for this funding it requires that the institution has a Carbon Management Plan including specific targets and identified projects to achieve these targets.

The HE sector target is for cuts in Scope 1 and 2 emissions of:

- **34 per cent by 2020 and 80 per cent by 2050 against a 1990 baseline**

which is equivalent to a reduction of

- **43 per cent by 2020 and 83 per cent by 2050 against a 2005 baseline**

These targets are for reductions in absolute emissions, so will be even more challenging in the context of growth of the University both since 1990 and 2005.

Other legal drivers include:

The Carbon Reduction Commitment: this new legislation commenced in April 2010 as an emissions trading scheme whereby all organisations of sufficient scale have to annually purchase emissions permits at an initial fixed price of £12/tonne CO_2, and later at a floating market rate. In the Comprehensive Spending Review in October 2010 this was significantly altered with all permit funds no longer being recycled back to the participants and the £12/t now "a matter for the Budget process". In effect this is now a simple Carbon Tax equivalent to at least an 8% rise in our energy costs, or £290,000 annually, and potentially more in future depending on the market rate. As well as this financial impact there will be published league tables based on performance highlighting the potential reputational issue for any organisation.

Display Energy Certificates (DECs): this legislation came into effect in October 2008. It requires all public sector buildings >1000m^2 floor area to display a certificate showing the energy performance of a building based on actual energy. A DEC is valid for one year and must be updated annually. It shows an A to G rating based on a comparison with a benchmark hypothetical building with a performance typical of its type, where A is the lowest CO_2 emissions (best) and G is the highest CO_2 emissions (worst). Also shown are the ratings for the previous two years; this provides information on whether the energy performance of the building is improving or not. This legal driver therefore results in a potential reputational driver as the information is freely available and displayed publically in each building. It is expected that this legislation will be expanded to include smaller buildings and also cover private sector buildings. The University has 46 buildings which are covered by DECs - see section 3.2 for more details.

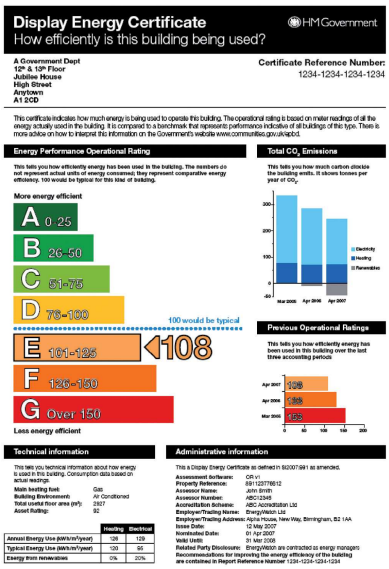

Figure 3 - Display Energy Certificate Example

2.1.2 Financial drivers

With the restraint in public sector funding and the restructuring of the HE sector comes an increased imperative to save energy and reduce carbon; the University's annual spend on energy is close to £5m and prices are expected to continue to rise globally over the medium to long term. This equates to 10% of non-salary costs, and 40% of the costs of running the whole University Estate.

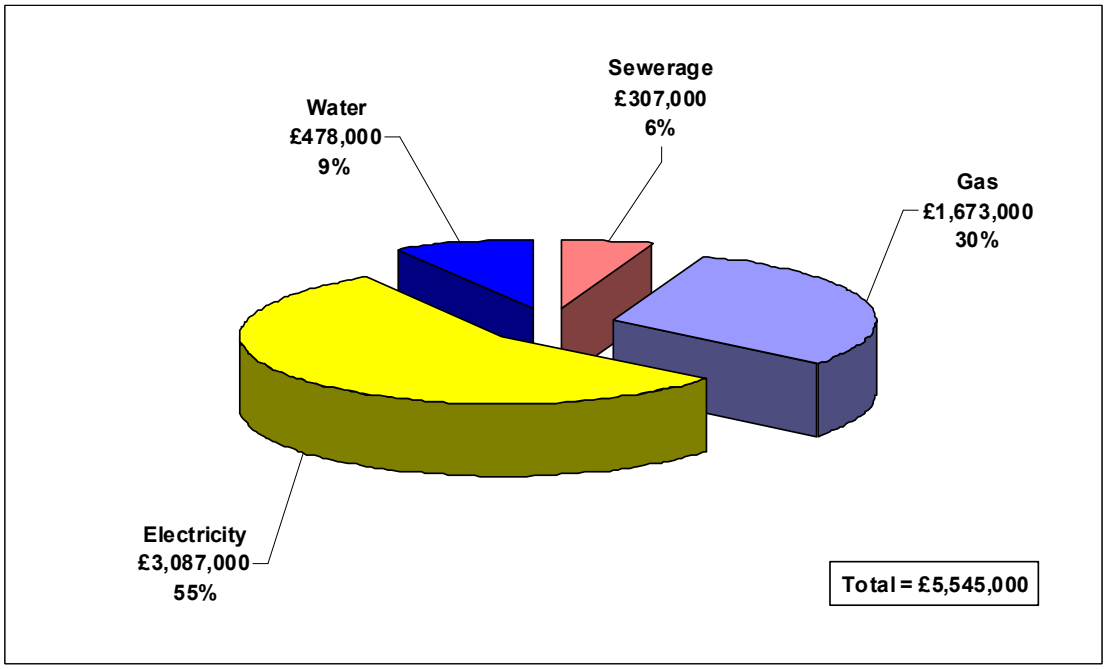

Figure 4 – University utility costs 2008/09

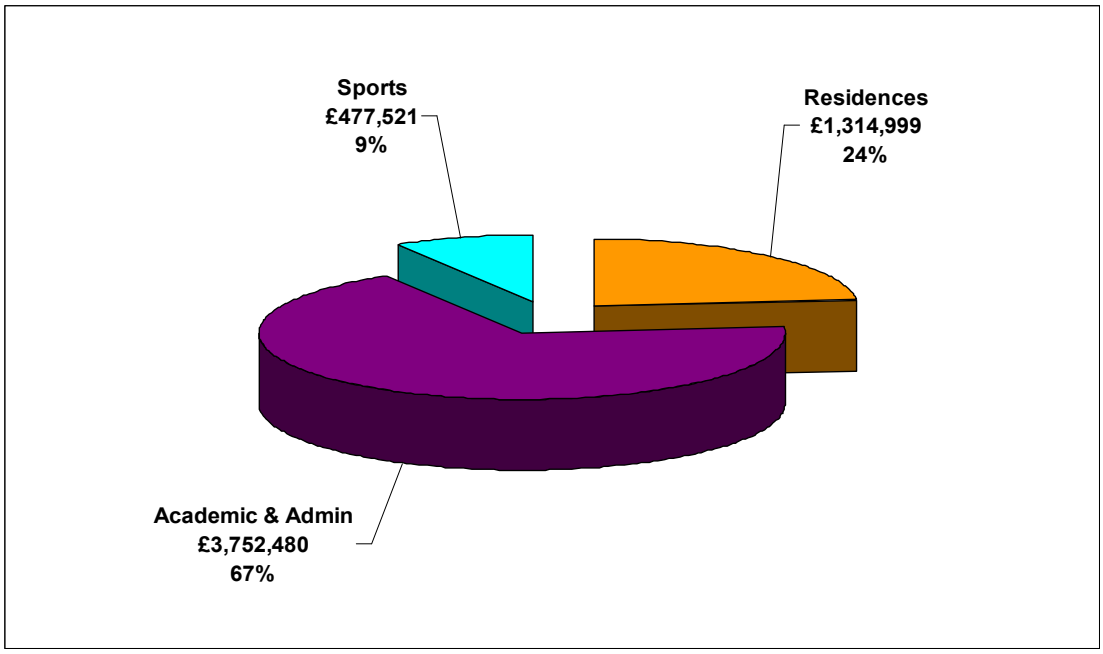

Figure 5 – Utility costs by area

2.1.3 Reputational issues

An organisation's reputation can be greatly enhanced, and potentially damaged, according to the public perception of its performance on 'green issues'. This can be of great importance within the University sector, especially in these times of fee-paying students and greater competition between institutions for students and top-quality researchers. Some attempt to benchmark universities' sustainability performance has been made through the People & Planet 'Green League' and the BITC Universities That Count benchmarking process and these have both been the subject of regular publicity. This has also started to appear on the international scene with examples such as the University of Indonesia GreenMetric ranking.

There are also a large number of prizes, awards and accreditations in the sustainability field, with the associated positive publicity, such as the EAUC Green Gown Awards, the Carbon Trust Standard, and the Green Tourism Business Scheme (GTBS) which can demonstrate a responsible approach and improve reputations. A strong performance in all sustainability matters will also be expected by existing staff and students, and will enhance relations with neighbours and other local stakeholders.

The University of Bath holds Carbon Trust Standard Accreditation, was the first British University to qualify for the GTBS Gold Award, and has previously been shortlisted for Green Gown Awards.

2.1.4 Internal Drivers

The University has a commitment articulated in our Corporate Plan 2009/10 - 2013/14 to the "ongoing development and enhancement of our physical infrastructure and specialist facilities to increase capacity, sustainability and quality". It also states that "Our values are evidenced in our commitment to ….. best environmental practice".

The University's Environmental Policy (see http://www.bath.ac.uk/estates/energy/policies.shtml) states that we have made a number of commitments to promote effective environmental management:

(i) To identify the environmental aspects of the University's operations and develop mechanisms to monitor and mediate the significant impacts of these.
(ii) To set targets on environmental performance and monitor the progress towards these targets.

The following targets have also been set:

- to achieve our initial target of reducing CO_2 emissions from the University's gas combustion and electricity usage by 12.5% from a 2003/04 baseline of 0.11 tonnes/m2 by December 2010;
- to develop, in partnership with the Carbon Trust, a Carbon Management Plan by March 2011. This will include a new carbon reduction target in line with the sector target of a 43% reduction in scope 1 and 2 emissions by 2020 based on 2005 levels;
- to establish a baseline for our Scope 3 emissions and set a reduction target.

As the University has expanded over recent years it has started to approach its capacity in certain infrastructure areas. One of significance is that the electricity supply to the University is approaching its maximum capacity and could exceed it under a 'Business as Usual' situation given any future expansion or intensification. The cost of upgrading the supply will be around £2m; potentially any substantial reductions in energy use could delay the need for, or avoid, this upgrade entirely. Any reductions in usage (or increase in self-generation) will also better protect against potential supply shortages or interruptions.

2.2 Strategic themes

The following are the key themes of this Plan and our approach to Carbon Management:

- **Taking the issue beyond Estates** - historically energy and carbon issues have fallen within the responsibility of the Department of Estates, and the majority of this plan builds on the work already done within Estates. Much will be required, however, to ensure saving carbon is an everyday issue for all departments and this is a key strategic theme of the plan.
- **Embedding carbon in decision-making** – it is essential that we consider carbon in any key decisions we make as an organisation.
- **Capital investment in technical infrastructure** – of course, much of the planned improvements will mean technical changes to the buildings, whether it is to the district heating system or to lighting controls.
- **Managing the data** – we have an extensive network of meters and a wealth of data, but the management, monitoring and communication of this is key to any success.
- **Behavioural change** – an individual's personal day-to-day behaviour can have a significant influence on carbon emissions and a means to build upon previous behavioural change programmes and improve our communications plan is required, aimed at both staff and students.
- **Laboratories** – another key theme is improvements in the energy-intensive laboratories which are a large proportion of our footprint. This will require technical changes, but also changes in behaviour of staff/students that use these facilities.
- **Funding** – we will continue to seek external sources of funding, but have planned for internal support primarily.
- **Links and partnerships** - we will continue to develop links with the academic community internally, with other organisations, both locally by, for example, building on the links of Our Big Energy Challenge, and also nationally/internationally within the HE sector.

2.3 Targets and objectives

Section 2.1.1 sets out the targets that have been set for the HE sector by government and HEFCE. We have initially set an aspirational target in line with this, and have used this carbon management planning process to help us understand whether this target is achievable.

The University of Bath will aim to reduce the Scope 1 and 2 CO_2 emissions from its activities by 43% by 2020 from a 2005 baseline

We have modelled a future trajectory towards the 2020 target and have set an interim 5 year target against a more recent baseline:

Our intermediate target is to reduce emissions by 19% by 2014/15 against a 2008/9 baseline – this document sets out an action plan to reach this target

Scope 3 target

Given the difficulties in accurately measuring and monitoring some Scope 3 emissions we have initially set a Scope 1 and 2 target only. The means to measure these emissions are being improved and it is intended that a Scope 3 target will be developed in the next 2 years. This plan includes some initial projects to reduce these emissions.

3 Emissions Baseline and Projections

3.1 Scope

Our baseline footprint includes all of Scope 1 and 2 emissions, and Scope 3 emissions due to transport (commuting, business travel, overseas student home trips), waste and water.

Data sources, measurement method and their accuracy are as follows:

Scope 1		
Emissions source	***Measurement method***	***Accuracy***
Gas	Metered data for all properties	Excellent level of accuracy
Oil	Oil dips and delivery records	Fair accuracy (but small quantities only)
Vehicle Fleet	Fuel purchase records	Good accuracy
Refrigerant loss	From servicing company records where top up required	Fair accuracy

Scope 2		
Emissions source	***Measurement method***	***Accuracy***
Electricity	Metered data for all properties	Excellent level of accuracy

Scope 3		
Emissions source	***Measurement method***	***Accuracy***
Water use	Metered for all properties	Excellent level of accuracy
Waste	Weight calculated by number of bin lifts and using standard conversion factors	Estimates
Student/staff commuting	Calculated based on data for travel surveys of students/staff, and data from 2002 for bus travel	Estimates
Business travel	Calculated based on University travel insurance records by country of destination and assumed air travel, cross-checked with sample data from expenses claims	Estimates
Overseas student home trips	Calculated based on number of overseas students by country of domicile and assumed single return trip by air	Estimates

In all cases the CO_2 conversion factors issued by the Carbon Trust have been used – these are the DEFRA-issued values as of Sept 2009.

Improvements in the accuracy of measurement in some areas, especially Scope 3, are planned for the future – see section 6.3 for more details.

The indirect carbon emissions associated with the supply chain for purchased goods and services also fall within the definition of Scope 3; it has been estimated that for the HE sector as a whole the additional footprint due to these would account for a further 25-50%. This has been excluded from this footprinting process, however, as no clearly agreed methodology or necessary data sources exist at present within the Carbon Trust, government or internationally – HEFCE is currently examining this area and we will await the conclusions and guidance. Even without measures, we are already taking steps to reduce our impact in this area – see section 6.5 for more details.

3.2 Baseline

Although some data for 09/10 became available during preparation of this strategy, the baseline has been kept at 08/09.

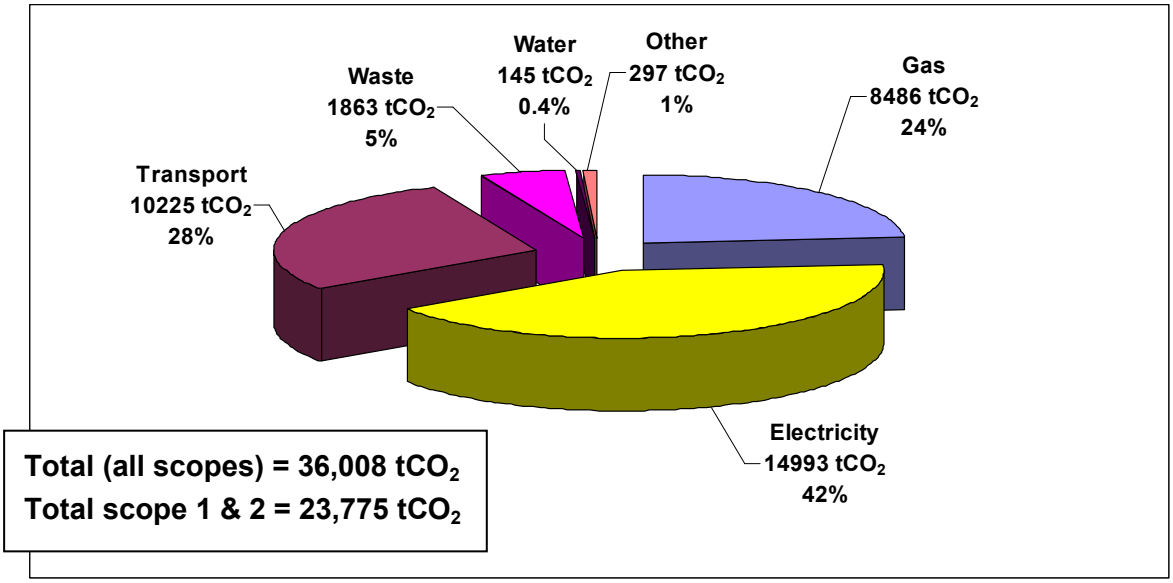

Figure 6 – 2008/09 carbon footprint

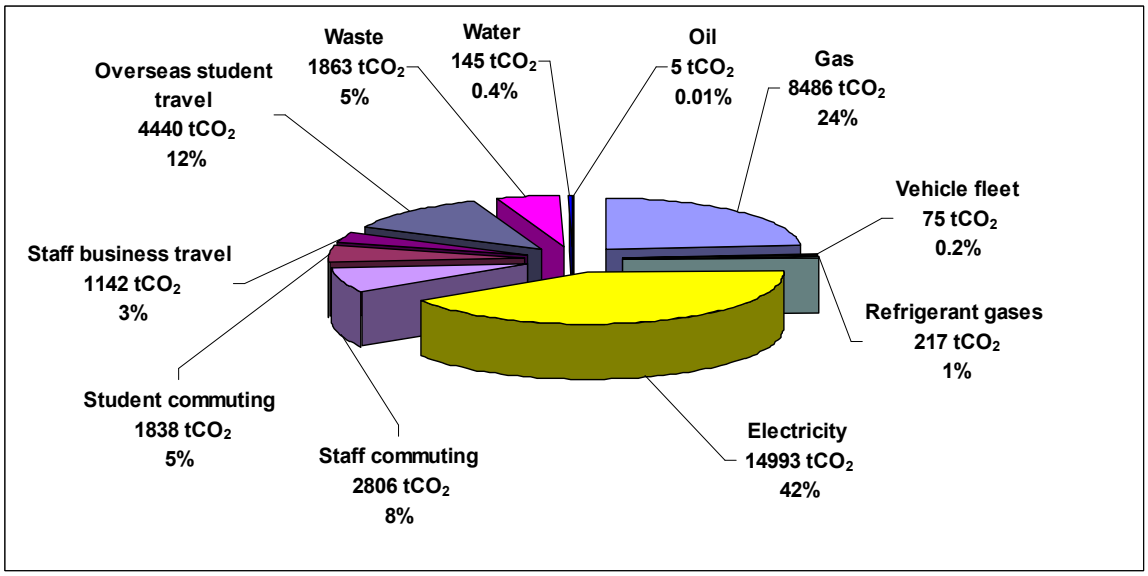

Figure 7 – a more detailed footprint breakdown for 2008/09

Section 1 highlighted that the scope of this carbon plan is for Scopes 1 and 2 only. The baseline under consideration is therefore that due to gas and electricity use predominantly, with small values for vehicle fleet and refrigerant gases.

Figure 8 below shows our historical emissions, the scale of our future targets, and the different timescales for the sector target and our interim target.

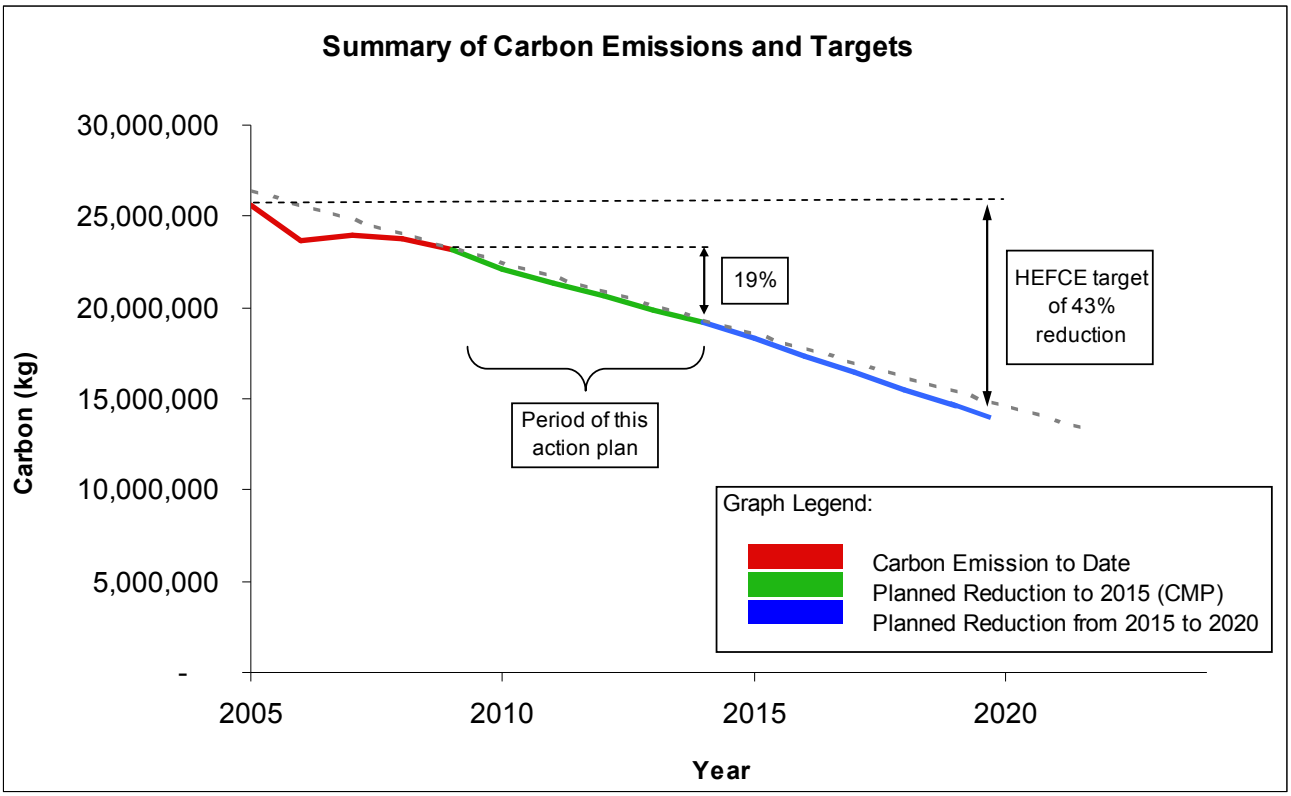

Figure 8 - Historical emissions and the scale of the future targets

In terms of our targets:

The University of Bath will aim to reduce the Scope 1 and 2 CO_2 emissions from its activities by 43% by 2020 from a 2005 baseline of 25,606 tCO_2

By the end of 09/10 we have already achieved a 9% saving against the 2005 baseline. This trend needs to be continued but at a faster rate of reduction.

Our intermediate target is to reduce emissions by 19% by 2014/15 against a 2008/9 baseline.

This equates to a reduction of 4600 tCO_2 on a baseline of 24,000 tCO_2. At the end of 09/10 we had already reduced our emissions by 600 tCO_2 or 3% against 08/09 levels due to our existing improvement activities.

The following graphs show the buildings and departments within the University that are responsible for the majority of emissions.

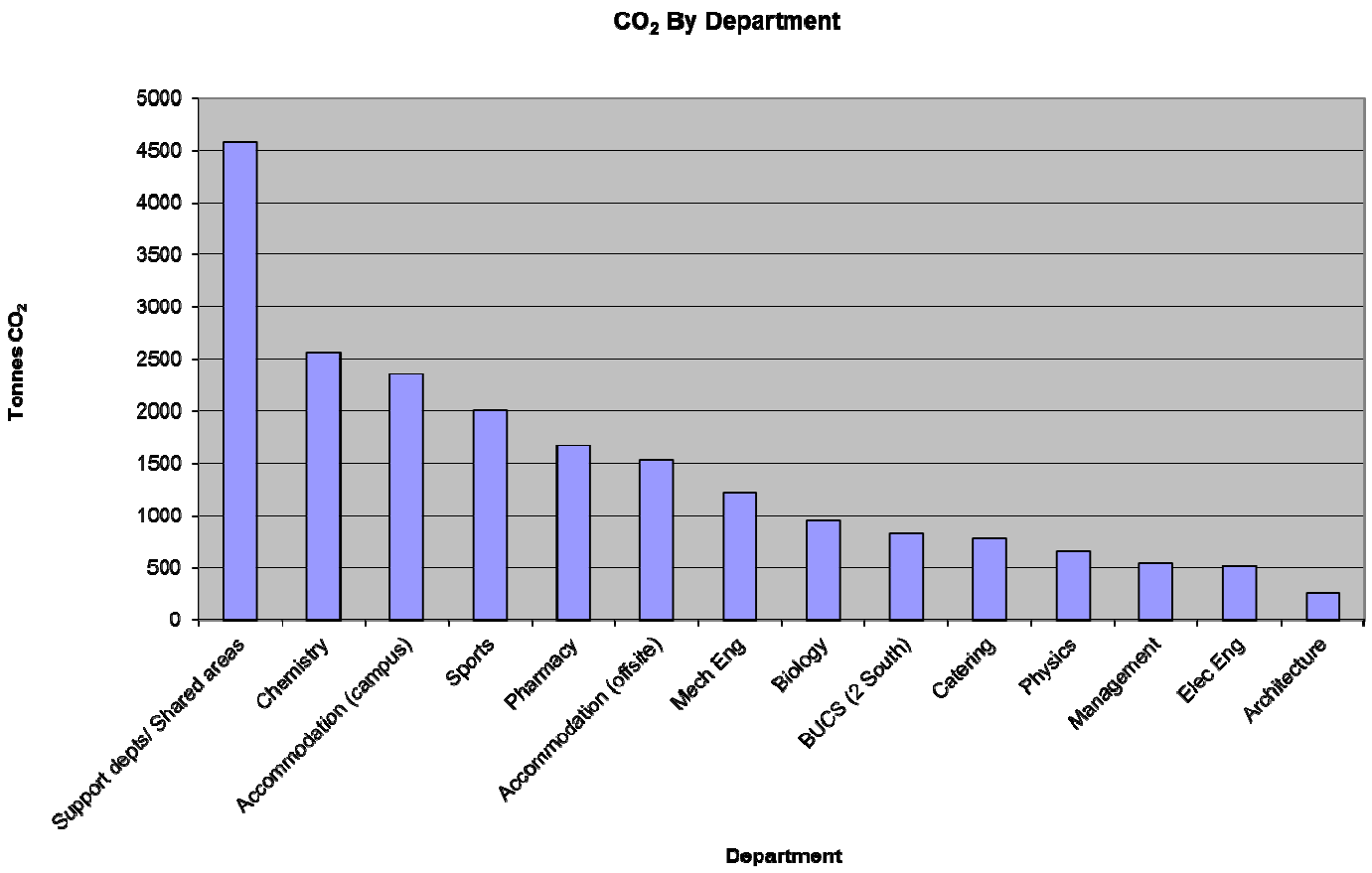

Figure 9 - Carbon footprint by department in 2009/10

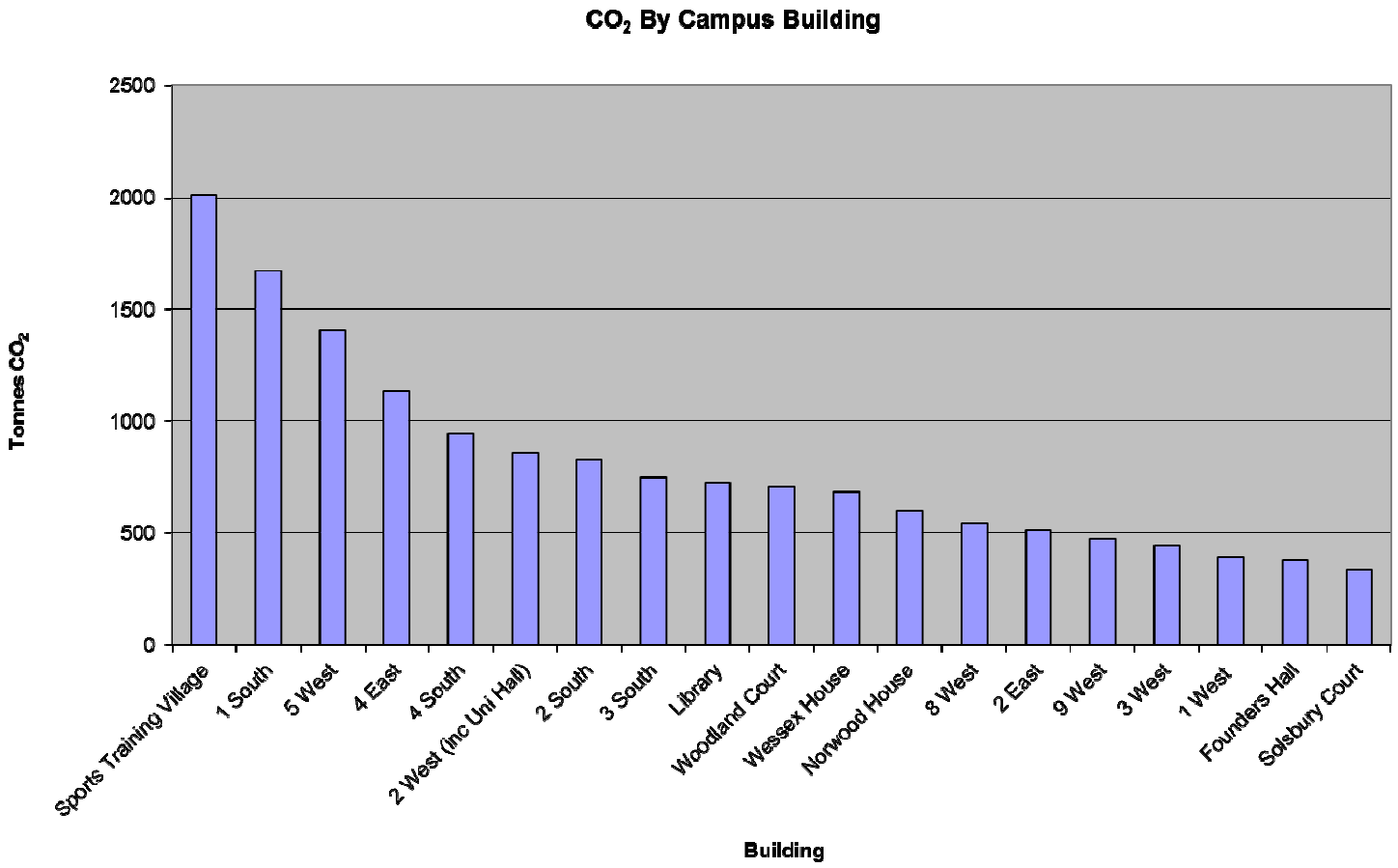

Figure 10 - Carbon footprint by building in 2009/10

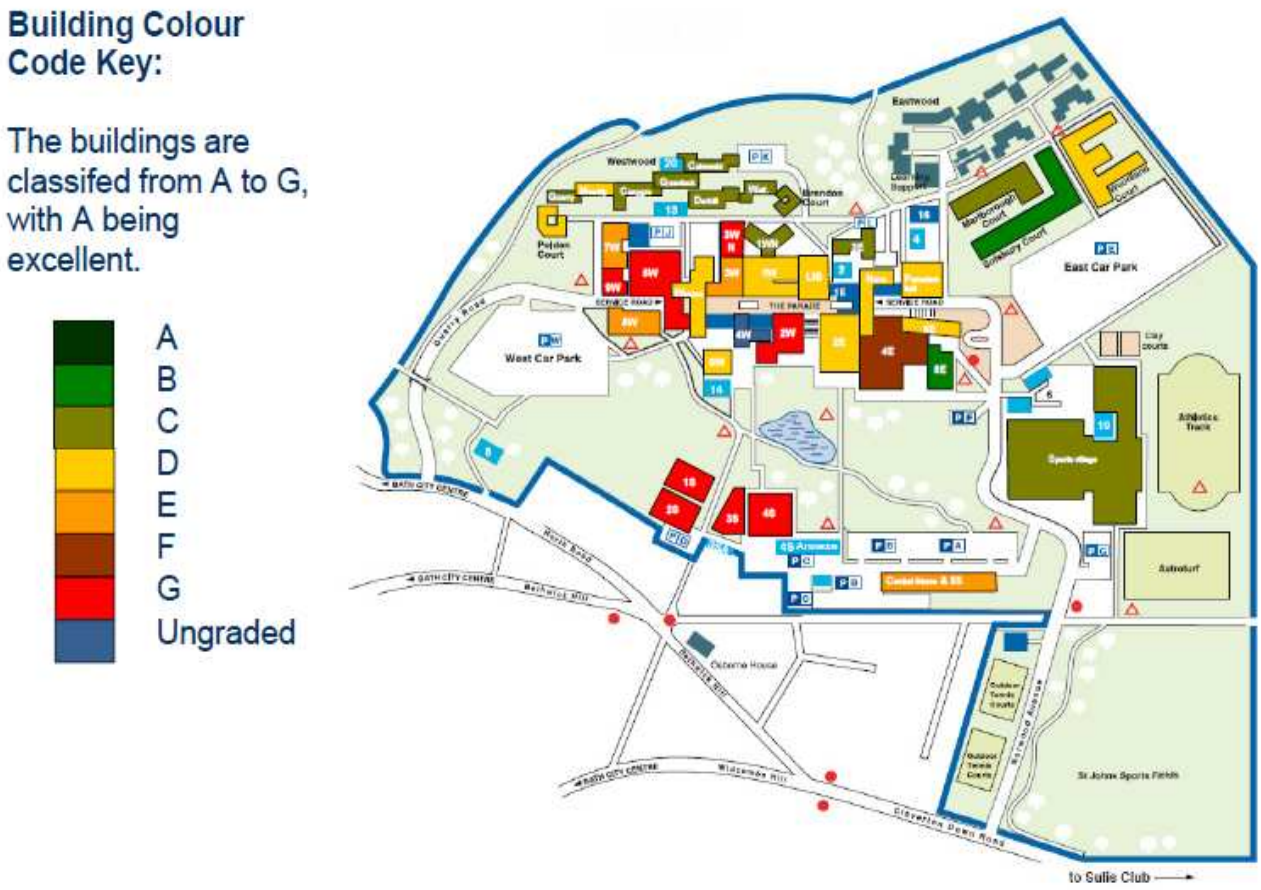

Figure 11 - Campus map with buildings coloured according to their Display Energy Certificate rating

Display Energy Certificates (DECs) are discussed in section 2.1.1.

A web version of this info with links to all the latest DECs for the buildings can be found at http://bathuni.energyprojects.net/

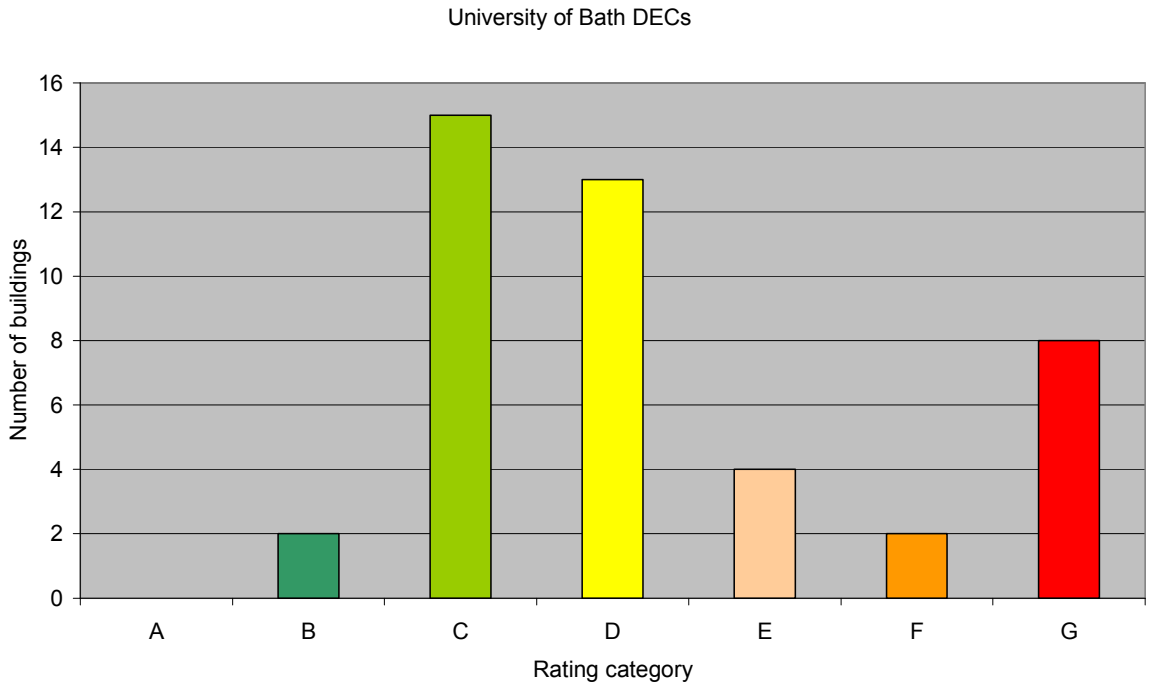

Figure 12 - Number of buildings in DEC rating categories

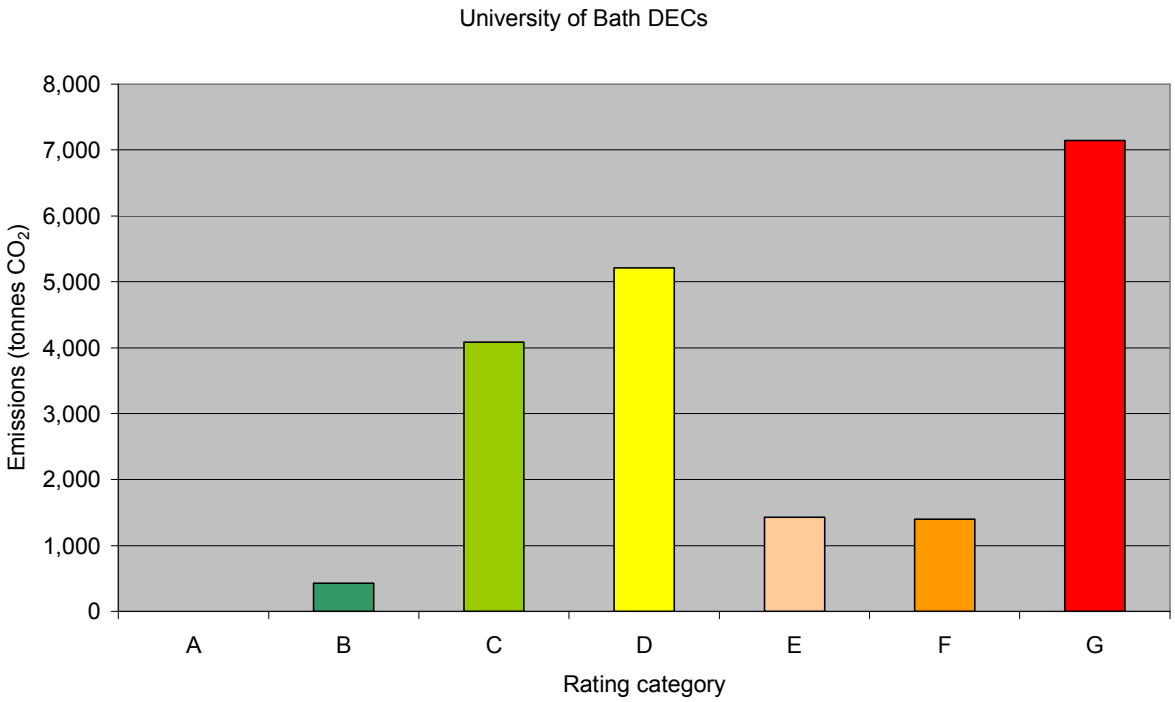

Figure 13 - Emissions per DEC rating categories

As can be seen from all of these figures, the energy consumption and carbon emissions in academic departments are dominated by science and technical departments with laboratories. These are generally highly-serviced areas and are therefore highly energy-intensive. **30% of our emissions come from the 8 G-rated buildings, which make up 14% of our floor area.**

3.3 Projections and Value at Stake

In the next five years, there will be some step change increases (eg new buildings) that will require an even greater effort to be made. We have included in the modelling any known or likely increases to emissions due to new buildings and other factors – **this growth is likely to be around 7% by 2015**, clearly making any absolute reductions in emissions even more challenging – **a saving of 25% (6,300 tCO_2) will actually be necessary.** This can be seen in Figures 14 and 15.

The following assumptions have been made:

- Business As Usual (BAU) increase in demand for all stationary sources and Fleet = 0.7%/year *(source DTI/DBERR EP68)*
- Carbon charges of £12/tCO_2 due to Carbon Reduction Commitment from 2011/12
- BAU increase in utility costs = 1.7% per annum *(source DECC Energy Cost Predictions June 2010 – central scenario)*

This last assumption can be seen as highly conservative. Energy prices are made up of the wholesale price which can be highly volatile, and non-commodity prices based on legislation and distribution costs. It is projected by government that non-commodity costs (distribution charges, Climate Change Levy, Renewables Obligation, etc) which make up 40% of the costs will increase by at least 45% by 2020 – this equates to the 1.7% annual increase as recommended by the Carbon Trust (based on BERR report) i.e. it does not cover increases due to wholesale market.

It is also possible that the £12/tCO_2 will be as high as £16/t as this is now open to being altered in the next government Budget.

The following step changes in emissions have been assumed from the 09/10 situation:

Year	***Building***	***tCO_2***	***% of total emissions***
2010/11	New buildings/projects already completed = 4 West, Student Centre, second BUCS server room, East Building (construction site and final building for portion of period)	930 tCO_2	+ 4%
2011/12	East Building fully occupied	210 tCO_2	+ 0.9%
2012/13	New Arts Building, extension to refurbished 1 West, and assumed additional single new academic or residential building	650 tCO_2	+ 2.7%

Future development plans also clearly depend on many other factors which are subject to change especially given the state of public sector finances and the fundamental changes in the HE sector. These projections, however, are seen as being the most likely situation at the time of writing. The extension to 1 West will be part of a major refurbishment project of the whole building, and this would be expected to deliver some savings – this has been included in the projections.

It can be seen that new buildings alone will potentially add 7.6% to our baseline emissions, meaning that any absolute reductions are even more challenging.

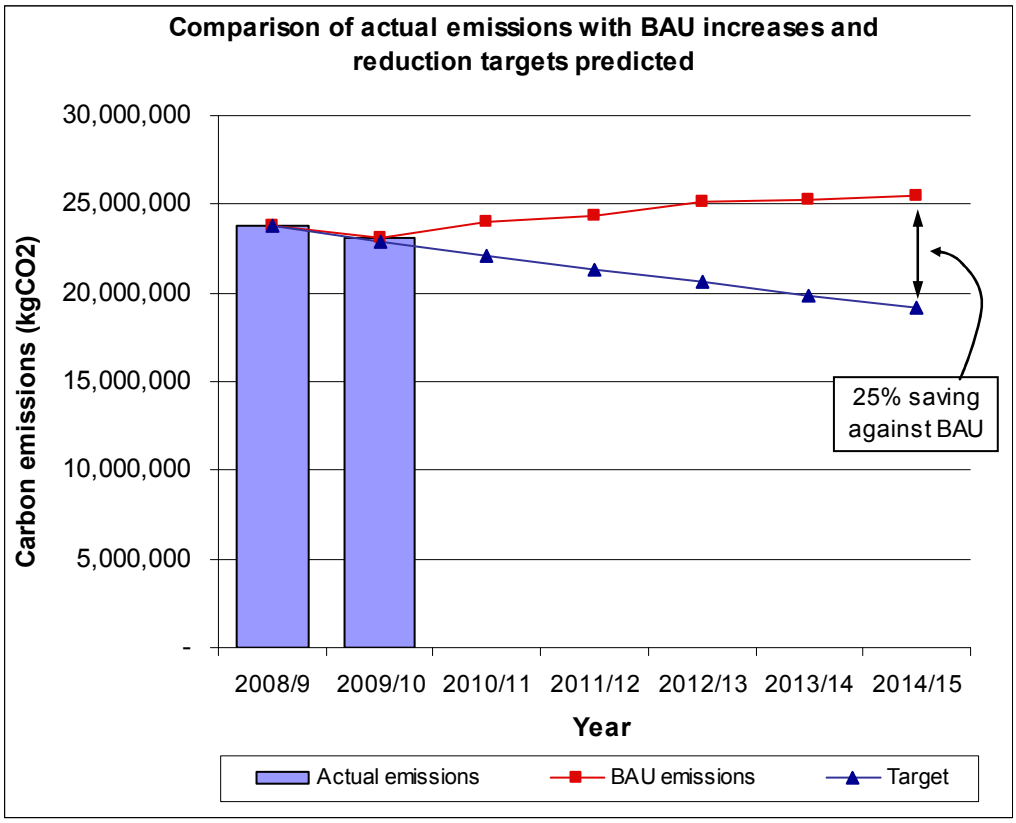

Figure 14 - BAU emissions and targeted emissions

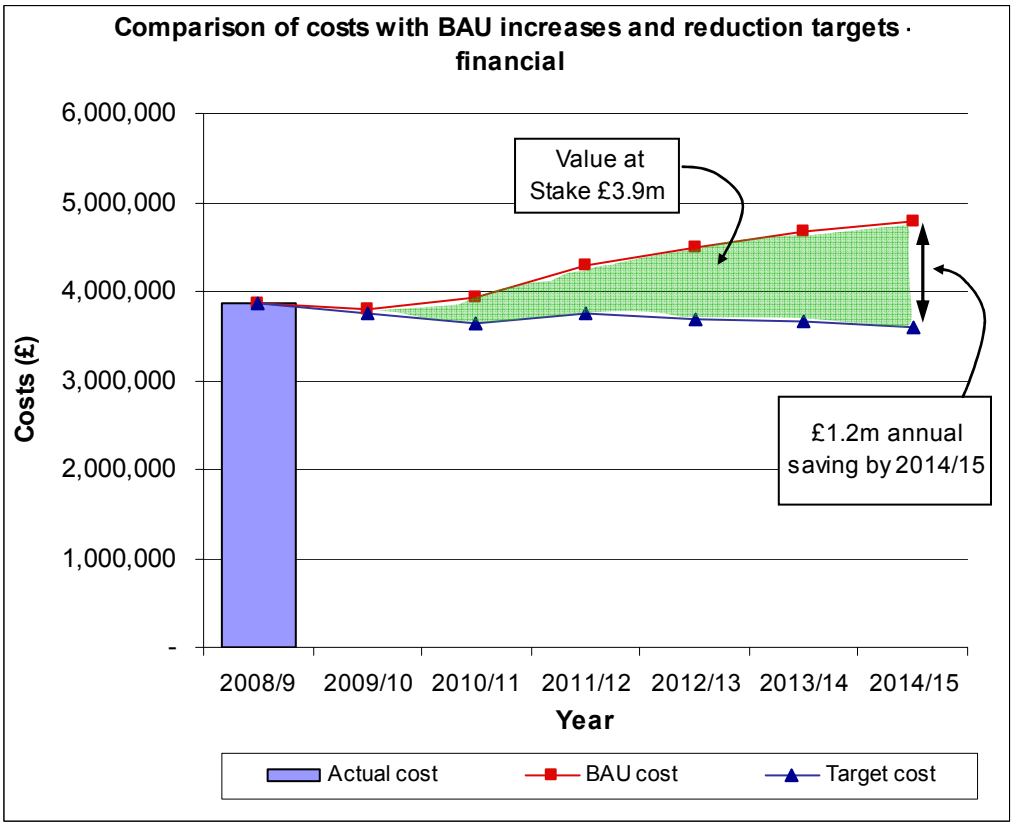

Figure 15 - BAU costs and targeted costs

The 'Value At Stake' (VaS) is the cost of doing nothing **– if we do not take this action to reduce emissions then we are putting at risk a value of £3.9m over the next 4 years.**

The annual Value At Stake by 2014/15 is £1.2m per annum – **not implementing this programme will result in an additional annual spend of £1.2m by 2014/15.**

This is based on conservative assumptions on energy costs i.e. it is likely that increases will be higher, and could potentially be significantly so. It can be seen from Figure 15 that this programme may not deliver any actual reduction in the energy costs, but merely allow us to avoid any increases.

4 Carbon Management Projects

This section sets out the proposed action plan we have identified to enable us to achieve our target. Details of some of the key projects are shown at Appendix B. It is not an exclusive or inflexible list of projects – further opportunities will be developed, some may not prove feasible when developed further (hence the advantage of identifying more than is needed to achieve our target), and there may also be substitutions. New technologies may also come forward.

Many projects have been excluded due to poor financial paybacks, or because insufficient information was available at this time. Some with poorer financial returns have been retained, however, due to other factors which are detailed where relevant, and generally because financial returns are not the sole driver for this action plan. Certain technical areas need further investigation, especially in the area of improving the overall fabric of the existing buildings, but these tend to have very long paybacks.

Savings and implementation costs are generally conservative and are based on the best available knowledge, whether this is Carbon Trust guidance, reports and surveys, case studies, or actual savings achieved previously within the University Estate. The sources of these projects include existing studies and ideas, planned projects, new surveys, workshops with the Carbon Management Team, meetings with key departments, best practice, and Carbon Trust tools.

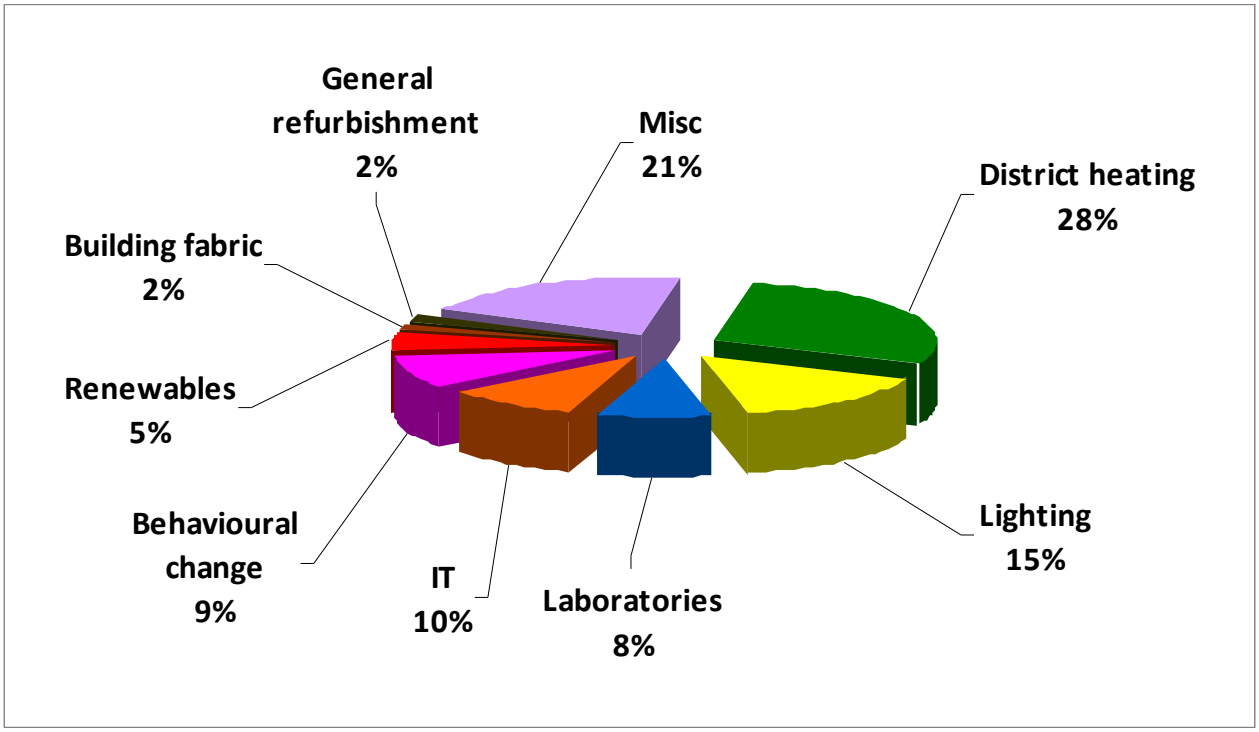

Figure 16 – Carbon savings identified by category

N.B. Note that in the following tables:

- *PIT stands for 'Project Implementation Team'*
- *Operating cost (opex) is the net overall operational costs occurring in each individual year. It reflects the non-energy costs and hence in some projects is a negative (favourable) value*
- *NPV is based on a 6% discount rate*
- *Percentage of target is relative to the interim 5 year target (i.e. a 19% reduction, not including BAU increases)*
- *Implementation year is the year that project is expected to commence, and where 2010 is stated this refers to the academic year 2010/11. In our modelling, emissions savings are not included until the first full year they will occur.*

4.1 Existing projects

These projects are already underway, have been already agreed, or have been recently completed but the savings did not occur in 09/10. These all have existing funding plans and therefore appear as having zero cost within this plan. Some of these have been instigated for reasons other than energy saving, such as general refurbishments, but have some emissions reduction as a result.

Ref	Project	Lead	Annual Savings (yr 1)		% of Target	Implementation Year
			Financial (Gross)	tCO_2		
CMP88	John Wood Court refurbishment - lighting	Patrick Abbott	£1,387	8	0.17%	2010
CMP89	Student Switch Off student residences energy competition	Peter Phelps	£9,630	54	1.19%	2010
CMP90	Managed print service - removal of old printers/photocopiers	Jo Andrews	£7,608	43	0.94%	2010
CMP91	John Wood Building refurbishment	David Grist	£3,852	22	0.48%	2009
CMP92	Clevelands building refurbishment	David Grist	£5,497	31	0.68%	2009
CMP93	Greenhouse lighting controls	Chris Davey	£15,793	89	1.95%	2010
CMP94	Norwood House refurbishment	David Grist	£3,852	22	0.48%	2010
CMP95	Project IOTA - Improvement of approx 50 General Teaching areas	John Still	£7,223	41	0.89%	2010
CMP96	Green Impact behavioural change project	Peter Phelps	£20,403	115	2.51%	2010
CMP97	Draughtproof Eastwood/Westwood residences	Steve Andrews	£21,009	117	2.57%	2010
CMP98	5 West steam plant/autoclaves	John Still	£5,593	31	0.68%	2010
CMP99	3E roof replacement and insulation	Steve Chasey	£1,530	9	0.19%	2010
CMP100	1 South corridor lights	Phil Auger	£4,815	27	0.60%	2010

These existing projects will save a total of 600 tCO_2, 2.5% of our total emissions, or will achieve 13% of our interim target. Two key projects, however (CMP 89 and CMP 96), are non-technical behavioural change projects and, if not continued, the savings will fall off rapidly. This is not necessarily an exclusive list, but summarises the main interventions that have taken place.

4.2 District heating projects

Ref	Project	Lead	Cost		Annual Savings (yr 1)		Pay back (yrs)	Net Present Value (NPV)	% of Target	Year
			Capex	Opex	Financial (Gross)	tCO_2				
CMP1	Recommission main CHP	PIT	£437,052	£8,400	£254,067	1459	1.8	£539,043	31.9%	2010
CMP2	Convert DH to low temperature	PIT	£1,049,796	-£6,600	£136,414	762	7.3	£129,516	16.7%	2011

These two key projects are linked and are Phase 1 and 2 of a strategy recently formulated for the district heating system that feeds the majority of the central campus buildings.

4.3 Lighting projects

Ref	Project	Lead	Cost		Annual Savings (yr 1)		Pay back (yrs)	Net Present Value (NPV)	% of Target	Year
			Capex	Opex	Financial (Gross)	tCO_2				
CMP42	Outside campus light improvements	PIT	£24,000		£3,852	22	6.2	£7,491	0.5%	2011
CMP26	STV Lighting improvements	Richard Hughes +PIT	£155,000	£0	£23,834	135	6.5	£39,849	2.9%	2011
CMP28	3 South Buildings common areas light upgrades	Richard Hughes +PIT	£32,500	£0	£4,815	27	6.7	£6,864	0.6%	2011
CMP25	Voltage reduction of outside lights (car parks)	Richard Hughes +PIT	£60,000	£0	£8,667	49	6.9	-£3,354	1.1%	2011
CMP27	1 South Buildings common areas lighting control	Richard Hughes +PIT	£50,000	£0	£7,223	41	6.9	£9,045	0.9%	2011
CMP29	4 South Buildings common areas light upgrades	Richard Hughes +PIT	£50,000	£0	£7,126	40	7.0	£8,258	0.9%	2011
CMP30	Phase 2 Lighting Buildings common areas lighting upgrades	Richard Hughes +PIT	£250,000	£0	£38,520	218	6.5	£64,908	4.8%	2012
CMP31	Phase 3 Buildings common areas lighting upgrades	Richard Hughes +PIT	£250,000	£0	£38,520	218	6.5	£64,908	4.8%	2013
CMP41	Offsite Accommodation Lighting improvements Common area	PIT	£116,016		£17,876	101	6.5	£30,121	2.2%	2013
CMP32	Phase 4 Buildings common areas light upgrades	Richard Hughes +PIT	£375,000	£0	£38,520	218	9.7	-£60,092	4.8%	2014

These projects will continue and accelerate the lighting improvement programme already in place in the University. Depending on the situation, the light fittings will be upgraded to the most efficient available and automatic controls installed, with a focus on communal areas as first priority.

Projects CMP 25 and CMP 32 have been retained despite a negative NPV, in the case of the former as this is marginal, it has a good payback and is well-developed project with less risk than others. CMP 32 is the final phase of a rolling programme of lighting improvements, replacing fittings and adding automated controls where relevant. We have assumed a higher cost in some areas due to these buildings containing asbestos which can make modifications more costly, but this is a conservative assumption and may not be necessary. All lighting projects also have a natural positive benefit due to the improved lighting levels of more modern

fittings and hence a better appearance of our internal space, and also because they are a highly visible improvement with a positive input on our behavioural change programmes.

4.4 Behavioural change projects

Ref	Project	Lead	Cost		Annual Savings (yr 1)		Pay back (yrs)	Net Present Value (NPV)	% of Target	Year
			Capex	Opex	Financial (Gross)	tCO_2				
CMP10	Continue Student Switch Off residences energy competition	Peter Phelps	£0	£9,000	£9,630	54	0.0	£427	1.2%	2011
CMP11	Continue Green Impact behavioural change project	Peter Phelps	£0	£35,000	£40,806	230	0.0	£15,022	5.0%	2011
CMP16	Energy info on web and display screens	Peter Phelps	£79,200	£15,000	£40,806	230	3.1	£20,070	5.0%	2013

The first two of these projects are existing projects at the University. It is planned to continue and expand these. Student Switch Off is a competition aimed at the student body living in halls of residence which has already been run with much success for a number of years (see http://www.bath.ac.uk/estates/energy/studentswitchoff2010.htm). Green Impact is a scheme aimed at staff which piloted in 2010 (http://www.bath.ac.uk/estates/energy/greenimpact.shtml)

4.5 Laboratories projects

Ref	Project	Lead	Cost		Annual Savings (yr 1)		Pay back (yrs)	Net Present Value (NPV)	% of Target	Year
			Capex	Opex	Financial (Gross)	tCO_2				
CMP50	Fume Cupboards - usage policy and behavioural change	Stephen Andrews	£5,000	£10,000	£25,599	144	0.3	£54,788	3.1%	2011
CMP54	Freezers -80°C Replacement	Stephen Andrews	£225,000		£27,927	158	8.1	-£42,473	3.5%	2011
CMP53	Freezers -20°C and -80°C Consolidation & housekeeping	Stephen Andrews	£0	£1,500	£1,844	10	0.0	£1,023	0.2%	2012
CMP51	Fume Cupboard - VAV System operation	PIT	£400,000		£51,197	287	7.8	£18,545	6.3%	2013

In section 2.2 it was highlighted that laboratories are a significant issue for the University. As an example, one fume cupboard typically consumes the energy equivalent of 3 houses and costs typically £800-1500 annually to run. We have 250 units on site and estimate that they are responsible for 15-20% of the non-residential gas use as well as significant electricity use. We also have many ultra-low freezers and highly serviced clean room areas, as well as much specialised research equipment. These projects are a mix of technical improvements and behavioural change in these areas.

CMP 54 has been retained despite a negative NPV as these calculations take no account of the fact that it is highly probable that much of the existing equipment will need replacing over the next few years anyway. The savings are also conservative estimates as there will be additional savings due to reduced heat output into cooled space.

4.6 IT projects

Ref	Project	Lead	Cost		Annual Savings (yr 1)		Pay back (yrs)	Net Present Value (NPV)	% of Target	Year
			Capex	Opex	Financial (Gross)	tCO_2				
CMP61	IT - screen replacement	TBA	£1,000		£905	5	1.1	£2,604	0.1%	2010
CMP62	IT - auto powerdown software	TBA	£29,200	£5,000	£12,519	71	3.9	-£422	1.5%	2011
CMP13	2 South server room upgrade and migrate departmental servers	PIT	£978,000	£0	£113,538	642	8.6	-£49,809	14.0%	2012

The key IT project here is the upgrade of the original 2 South server room. A second server room was installed elsewhere on campus in 2010 to increase resilience in our IT systems; this has a 'best in class' energy efficiency making use of free cooling 75% of the year. Project CMP13 is to upgrade 2 South similarly. This has a negative NPV but is still worthwhile implementing as it is only marginally so with an IRR of 5.1%, has some other benefits in terms of freeing up space and also as it can be assumed that the IT requirements of the University will only increase in the future along with the savings.

4.7 Renewables projects

Ref	Project	Lead	Cost		Annual Savings (yr 1)		Pay back (yrs)	Net Present Value (NPV)	% of Target	Year
			Capex	Opex	Financial (Gross)	tCO_2				
CMP83	Residences solar thermal	PIT	£231,250	-£20,400	£4,935	28	9.1	£7,224	0.6%	2012
CMP6	Biomass boiler for South buildings	PIT	£286,044	-£67,000	£10,736	216	3.7	£452,449	4.7%	2013
CMP4	Biomass boiler for STV	PIT	£232,320	-£43,000	£6,561	132	4.7	£238,943	2.9%	2013
CMP84	Residences solar PV	PIT	£355,000	-£19,698	£7,078	40	13.3	-£33,105	0.9%	2013

The use of renewables for self-generation tends to be a high visibility subject. The University currently has 6 solar thermal systems on student residences and an academic block, and has recently installed 145m^2 of solar PV panels on the new East building due to open Spring 2011. We have also investigated many other possibilities over the past 5 years.

The priority, however, should always be for reduction before self-generation – this is the correct energy management hierarchy. This also makes sense in terms of investment of time and money as there is usually a much greater return on minimisation both in financial terms and in terms of emissions savings.

Government incentives such as Feed In Tariffs (FITs), Renewable Obligation Certificates (ROCs) and the Renewable Heat Incentive (RHI) have started to make some projects viable and we have selected a number here, although the paybacks on some are longer than the majority of projects. Additionally, there is some uncertainty as the RHI will not be introduced until June 2011 and both this and FITs were under review at the time of writing.

It is recognised that in the eyes of the general public, renewables have a high visibility and association with reducing carbon emissions therefore ensuring we make the most of any publicity benefits of existing and planned renewables will only help our internal behavioural change. This is also part of the justification for CMP 83 and 84 looking at solar power. Although these have poorer paybacks, the publicity and behavioural change impact could be significant. Additionally, there are also other financial vehicles that will be investigated further as the FITs (and presumably the RHI) are guaranteed for 25 years making it an attractive investment for external funds via leasing of roof space or a joint venture via a Newco or similar.

The University has researched wind power with Partnership for Renewables, a subsidiary of the Carbon Trust. Owing to planning risks and serious objections likely to arise from the local community, we do not see this type of installation as being appropriate in this plan. We expect such installations will become less controversial as time goes on and this will be kept under review.

There is also the complication in that renewables projects such as wind, solar, and biomass may not be allowed to count towards an organisation's carbon-saving targets if these government incentives are claimed; there is a potential for double-counting due to the carbon being embodied within the incentive. However, the guidance from HEFCE is that emissions reductions achieved from renewable energy can be claimed by the University. This was not fully resolved at the time of writing.

4.8 Miscellaneous projects

Ref	Project	Lead	Cost		Annual Savings (yr 1)		Pay back (yrs)	Net Present Value (NPV)	% of Target	Year
			Capex	Opex	Financial (Gross)	tCO_2				
CMP14	Heating and air-con policy and enforcement	Peter Phelps	£0	£0	£40,806	230	0.0	£162,455	5.0%	2011
CMP56	HVAC/Air-Conditioning - check all BMS time schedules match occupancy	Stephen Andrews	£3,000		£7,078	40	0.4	£25,179	0.9%	2011
CMP75	Vehicle fleet - driver training programme	Greg Dargue	£2,000	£500	£3,281	8	0.7	£8,954	0.2%	2011
CMP57	HVAC/Air-Conditioning - check all BMS temperature settings	Stephen Andrews	£3,000		£1,445	8	2.1	£2,751	0.2%	2011
CMP46	Improve pipe insulation and fit valve covers	PIT	£25,000		£4,606	26	5.4	£5,104	0.6%	2011
CMP18	Upgrade loft space insulation - Eastwood/Westwood residences	PIT	£50,600	£0	£2,435	14	20.8	-£26,492	0.3%	2011
CMP20	Instigate full PPM approach on all doors and windows	Greg Dargue	£5,000	£40,000	£29,610	166	does not payback	-£55,613	3.6%	2011
CMP65	HVAC/Air-Conditioning - CO2 sensors	PIT	£5,000	£0	£4,931	28	1.0	£35,308	0.6%	2012
CMP68	Swimming Pool - Liquid cover	PIT	£11,000	£1,000	£9,870	55	1.2	£46,149	1.2%	2012
CMP59	HVAC/Air-Conditioning - upgrade controls/replacement	PIT	£31,719		£8,225	46	3.9	£22,039	1.0%	2012
CMP44	Voltage reduction STV	PIT	£109,670		£13,482	76	8.1	£548	1.7%	2012
CMP70	Draughtproofing 5 West and Off-Site openable windows	PIT	£126,000		£15,463	86	8.1	£16,679	1.9%	2012
CMP48	BMS fine tuning campus	PIT	£55,000	£15,000	£20,679	116	9.7	-£30,244	2.5%	2012
CMP17	Implement full M&T software and analysis systems	Peter Phelps	£30,000	£50,000	£81,612	459	0.9	£84,292	10.1%	2013
CMP49	BMS improvements offsite	PIT	£10,000		£3,431	19	2.9	£12,421	0.4%	2013
CMP43	Metering improvements - submeter 2E, 8W, Wessex, 3W, 4E, 6E, 8E, M, N and H Subs, Boiler House, 2W, 1W, 1WN	Phil Auger	£168,750		£26,001	147	6.5	£43,813	3.2%	2013
CMP5	Thermal store for STV CHP plus EIS heat load	PIT	£123,420	£3,500	£11,359	64	15.7	-£58,752	1.4%	2013
CMP72	Draught lobby 2E or 4E	PIT	£20,000	£0	£987	6	does not payback	-£10,893	0.1%	2013

These projects cover a range of categories. Several are related to HVAC (Heating Ventilation & Air Conditioning) and related controls. All buildings on campus are controlled via a sophisticated Building Management System (BMS) but some improvements can be made in this area (CMP 56, 57 and 48). A key area is around standardising our policy and approach towards heating especially (CMP 14) – some work has already taken place to reduce unnecessary heating of buildings out of hours and prioritising the room bookings system towards our more efficient or controllable buildings. This needs to be taken a step further by formulating a standard policy, in conjunction with Health & Safety, regarding heating hours, temperatures, space management and portable devices.

Projects with less favourable financial cases will again have a good reason for being included in this plan, eg. CMP18 loft space insulation – although a long payback this is a low-effort project with good lifetime carbon savings due to the longevity of the improvement, and it is felt that the savings are very conservative due to the long heating hours of the residences (this is also just bringing the insulation up to current standards for new buildings). CMP20 is related to windows and doors and instigating a systemised maintenance approach to these – the savings could be significantly greater than has been assumed here, and there is a significant positive spin-off in comfort and perception/behavioural change. CMP 5 has been retained as the payback as calculated by other methods is 8 years with a positive NPV of £17k and therefore warrants further investigation as this may simply be due to an over-conservative approach being used here.

4.9 Long term projects

It is worth highlighting at this stage an additional long term project which falls outside of the 5 year timeframe of this plan. This is linked to the district heating projects in section 4.2 and should be seen as the 3rd phase of the strategy for this system.

Larger CHP plus expand District Heating Network

In 5-10 years time the existing CHP unit will have reached the end of its serviceable life. The choice then is to

- Replace with similar unit – capital cost £1m - maintains 2,222 tonnes CO_2 savings and £374k annual saving from first two district heating projects (CMP1 and CMP2)

or:

- Replace with larger CHP unit and expand district heating network to take in residences and some additional academic buildings – capital cost £4m – maintains above savings plus additional 1600 tonnes CO_2 and additional £150 – 400k annual saving.

There is also the option to replace with a bio-oil CHP, with greater carbon savings, but this option needs further investigation as there are greater technical and financial uncertainties.

4.10 Projected achievement towards target

Figure 17 below shows the projected emissions from implementing this plan. We have assumed a conservative 3%/year degradation factor on all emissions savings to allow for the fact that projects intrinsically become less effective over time.

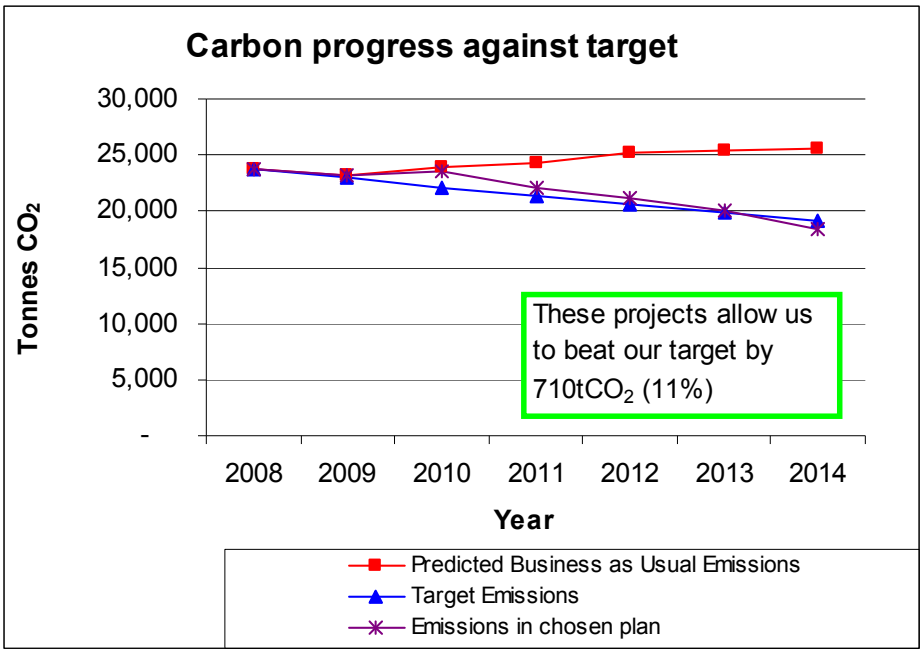

Figure 17 - Carbon reduction progress against target

4.11 Scope 3 emissions

This plan has not at this stage included the modelling of detailed actions to reduce Scope 3 emissions, but this section highlights what has already been achieved in this area and some of our actions moving forward.

Enhancing the sustainability of our infrastructure is a key pre-requisite in our Corporate Plan. Managing our environmental impact is securely embedded within our organisational structures and policies for infrastructure and facilities management. Our Environmental Policy provides an institutional framework, with clear corporate objectives and targets, to ensure that departmental activities are supporting our common purpose.

Executive Committee has oversight of the development and implementation of the Environmental Policy and for monitoring environmental performance. An annual report on environmental performance is published on our website.

Recent highlights include:

- Design – we have achieved the eco-design BREEAM 'Excellent' for our two most recent new build projects, a residential block and an academic building.
- Procurement – we have published an Environmental Sustainability Purchasing Policy and achieved Fairtrade University status.
- Recycling and waste reduction – we have invested £150k in a new waste management site to improved recycling rates, rationalised our waste contracts, provided more recycling points, removed waste bins from individual offices and moved to a minimal paper approach for admissions.

- Transport – the percentage of people driving to campus has fallen from 37% to 34%, the number of people walking to campus has increased from 3.2% to 8% and the number cycling has increased from 1.5% to 2%. The peak number of parked cars has decreased by 7%. Cycle parking provision has increased by 24%.
- Water use – we have reduced our water use by 7%, saving 20,000m^3 of water annually.
- We have participated in the environmental benchmarking project 'Universities That Count' since the HERDA-SW pilot project in 2007, achieving 'Outstanding' scores for the Climate Change and Design & Build sections.
- We are one of 20 Universities participating in the 'Degrees Cooler' pilot to encourage pro-environmental behaviour.
- We are running the 'Green Impact' project across campus with over 40 teams or departments taking part.

Our relevant awards include:

- a 'Silver' award for our Students' Union for 'Sustainability in the NUS' Sound Impact awards.
- a 'Gold' award for Accommodation & Hospitality under the Green Tourism Business Scheme, now working towards ISO14001.
- a shortlist for construction in the Greener Gown awards in 2009.
- a 'Gold' award for green transport in the West of England Travel Plan Awards.

Our future plans include:

- Continuing and expanding the Green Impact project and building on this valuable network of keen, active individuals.
- Implementing a new Travel Plan for the campus.
- Achieving ISO 14001 in Accommodation & Hospitality Services and possibly using this as a model for other areas.
- Recruiting a full-time Waste Manager.

In these and other areas that impact on Scope 3 emissions we will develop action plans in line with the targets within our Environmental Policy:

Water:

- To reduce our water consumption in existing buildings by 15% in 3 years from a baseline of 2009/10.

Transport:

- Develop and publish a new Transport Plan by 2011.
- Improve the bus arrivals area to improve the experience for passengers and facilitate the operation of competing bus services.
- Develop a methodology, in partnership with our transport consultants, to provide a credible estimate of carbon emissions for travel associated with commuting to campus, business trips and international students visiting their country of domicile.
- Continue to work towards reducing the demand for car parking places on campus.
- Increase cycle storage, including covered, secure storage, on campus by a further 10% by 2011/12.

Waste:

- Our targets are to increase recycling from 11% of total waste in 2008/09 to:
    - 30% by 2012/13
    - 50% by 2014/15
    - 65% by 2019/20

In addition, our total waste production in terms of both volume and weight should not increase from our 2009/10 baseline.

Sustainable Procurement:

By March 2012, we will have:

- Provided targeted refresher training on the latest sustainable procurement principles.
- Augmented the environmental sustainability purchasing policy with a strategy covering risk.
- Assessed all contracts for general sustainability risks and identified management actions.
- Implemented a targeted supplier engagement programme, promoting continual sustainability improvement.
- Applied a life-cycle approach to cost/impact assessment.

5 Carbon Management Plan Financing

To implement these projects we will need an investment of £6.5m over the 5 year period of this plan. This is in addition to the investment that the University currently makes via its major capital projects and maintenance funds.

The financial value at stake for this programme as compared with a Business As Usual model is £3.9m over the plan period to 2014/15. If this plan is achieved the annual savings will be £1.26m; these values are based on a highly conservative assessment of future utility prices.

The overall payback of the investment is 5.4 years, the NPV is £1.64m, and the Internal Rate of Return 10.8%.

5.1 Assumptions

The following prices have been used in the analysis for these projects:

- Electricity: 9.63 p/kWh
- Gas: 3.29 p/kWh

These are based on current rates with a simplification of the complex charging mechanisms and different contracts, and include CCL and VAT at 20%. They also include charges due to the Carbon Reduction Commitment at £12/tCO_2.

Section 3.3 has set out how these are conservative price assumptions.

It has also been assumed that all funds are from within the University. It is possible that other sources of funding may become available, but this is not clear. Possible examples include:

- The University has an externally-funded SALIX fund of £250k (also known as HEFCE Revolving Green Fund). This allows approx £100k/year for projects with paybacks of less than 5 years. SALIX is a not for profit social enterprise using government funding to encourage public sector energy efficiency, and may continue. If it does we may be able to expand the fund but this is not yet clear.
- SALIX Energy Efficiency Loans are also available – these are independent of the normal SALIX fund but with the same 5 year payback criteria and again paid back from savings. It is also unclear if these will continue beyond March 2011.
- The current government has indicated it plans to introduce a Green Investment Bank - the Green Deal proposal is not expected until Autumn 2012.

Capital costs are fully inclusive of VAT at 20%, and include some contingency and project management costs/fees where relevant.

We have also assumed:

- Financial discount rate: 6%
- Inflation rate: 2.5%
- "Persistence" discount rate on emissions savings: 3% degradation/year

Future cash flow is in real terms not allowing for inflation

5.2 Benefits / savings – quantified and un-quantified

The following is a summary of the financial and carbon savings of this plan:

	2010/11	2011/12	2012/13	2013/14	2014/15
Annual cost saving	**£62,394**	**£383,566**	**£730,801**	**£962,288**	**£1,258,452**
Annual CO_2 saving	**351**	**2183**	**4056**	**5240**	**7002**
% of target achieved	**8%**	**48%**	**89%**	**115%**	**153%**
% of target achieved (incl. BAU growth)	**6%**	**35%**	**64%**	**83%**	**111%**

These are some of the unquantified benefits:

- Meeting regulatory compliance and compliance with HEFCE Capital Framework requirements
- Improved reputation to attract potential students (home and overseas) and staff
- Improved reputation with existing staff, students, general public and other stakeholders
- Improved position in Carbon Reduction Scheme 'league table'
- Improved position in People & Planet 'Green League' and other benchmarking schemes
- Improved Display Energy Certificates performance
- Improved aesthetics and working conditions of existing buildings due to new lighting, improved heating control etc

5.3 Additional resources

This plan assumes no additional permanent staff at this stage. We have allowed for Project Management costs and additional temporary staff within the costs of specific projects. The majority of projects will be implemented by a Project Implementation Team (PIT) to be formed within Estates with additional contracted project management and consultant support.

5.4 Financial costs

The following is a summary of the costs of the programme:

Discounted Costs	2010/11	2011/12	2012/13	2013/14	2014/15
Total annual capital cost	**£438,052**	**£1,769,096**	**£1,797,639**	**£2,070,750**	**£375,000**
Total annual operational cost	**£0**	**£52,400**	**£101,300**	**£98,400**	**£37,202**
Total costs	**£438,052**	**£1,821,496**	**£1,898,939**	**£2,169,150**	**£412,202**

Operational costs here and in section 4 are the net overall operational costs occurring in each individual year. It reflects the non-energy costs and hence in some projects is a negative (favourable) value due to the revenue from FITs, RHI, the export of electricity and any savings on maintenance. This particularly applies to the 2013/14 and 2014/15 academic years when the impact of the 4 renewables projects with negative operating costs due to government incentives are seen.

The following is a summary of the paybacks for the projects:

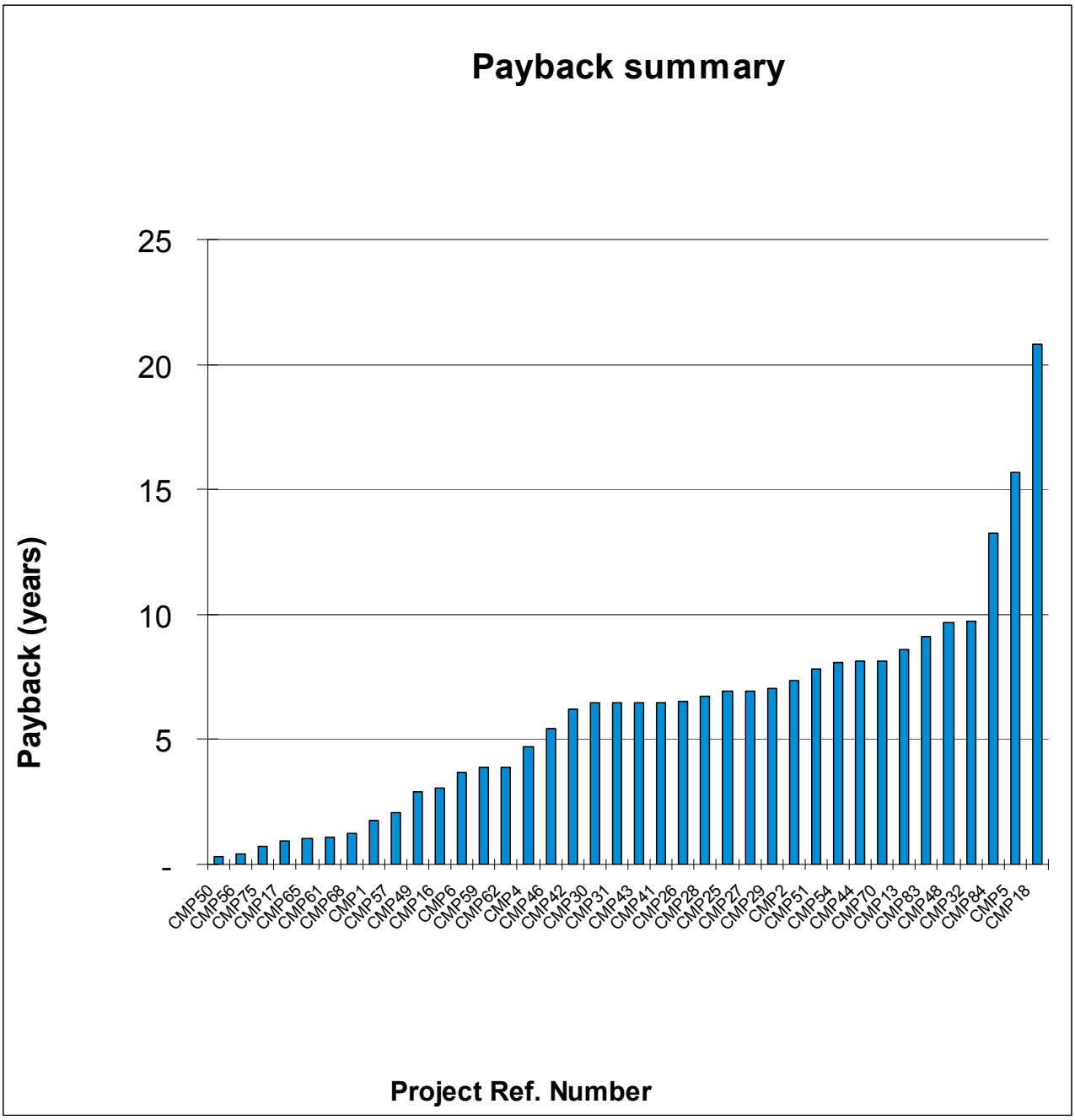

Figure 18 - Payback Summary

Paybacks are simple, based on initial energy costs only.
The average payback of the overall programme is 5.4 years.

Project Ref. Number	Description of Project	Simple Payback (years)
CMP50	Fume Cupboards - usage policy and behavioural change	0.32
CMP56	HVAC/Air-Conditioning - check all BMS time schedules match occupancy	0.42
CMP75	Vehicle fleet - driver training programme	0.72
CMP17	Implement full M&T software and analysis systems	0.95
CMP65	HVAC/Air-Conditioning - CO2 sensors	1.01
CMP61	IT - screen replacement	1.10
CMP68	Swimming Pool - Liquid cover	1.24
CMP1	Recommission main CHP	1.78
CMP57	HVAC/Air-Conditioning - check all BMS temperature settings	2.08
CMP49	BMS improvements offsite	2.92
CMP16	Energy info on web and display screens	3.07
CMP6	Biomass boiler for South buildings	3.68
CMP59	HVAC/Air-Conditioning - upgrade controls/replacement	3.86
CMP62	IT - auto powerdown software	3.88
CMP4	Biomass boiler for STV	4.69
CMP46	Improve pipe insulation and fit valve covers	5.43
CMP42	Outside campus light improvements	6.23
CMP30	Phase 2 Lighting Buildings common areas lighting upgrades	6.49
CMP31	Phase 3 Buildings common areas lighting upgrades	6.49
CMP43	Metering improvements - submeter 2E, 8W, Wessex, 3W, 4E, 6E, 8E, M, N and H Subs, Boiler House, 2W, 1W, 1WN	6.49
CMP41	Offsite Accommodation Lighting improvements Common area	6.49
CMP26	STV Lighting improvements	6.50
CMP28	3 South Buildings common areas light upgrades	6.75
CMP25	Voltage reduction of outside lights (car parks)	6.92
CMP27	1 South Buildings common areas lighting control	6.92
CMP29	4 South Buildings common areas light upgrades	7.02
CMP2	Convert DH to low temperature	7.34
CMP51	Fume Cupboard - VAV System operation	7.81
CMP54	Freezers -80°C Replacement	8.06
CMP44	Voltage reduction STV	8.13
CMP70	Draughtproofing 5 West and Off-Site openable windows	8.15
CMP13	2 South server room upgrade and migrate departmental servers	8.61
CMP83	Residences solar thermal	9.13
CMP48	BMS fine tuning campus	9.68
CMP32	Phase 4 Buildings common areas light upgrades	9.74
CMP84	Residences solar PV	13.26
CMP5	Thermal store for STV CHP plus EIS heat load	15.70
CMP18	Upgrade loft space insulation -Eastwood/Westwood residences	20.78

6 Actions to Embed Carbon Management in Your Organisation

We assessed our current level of embedding before this process started using the matrix in Appendix A. As can be seen, a reasonable level has already been achieved, but further improvements are needed in some key areas; the following section sets out the current situation and improvements we will be making.

6.1 Policy – embedding CO_2 saving across your organisation

Current situation

- We have had an Environmental Policy since 2005. This was updated in September 2010 and now has specific reference to carbon (see http://www.bath.ac.uk/estates/energy/pdf%20files/Environmental%20Policy%202010.pdf).
- We have had a specific target to reduce carbon emissions by 12.5% per m^2 floor area against 2003/4 levels in place since 2005, which we have achieved by 2010.
- Energy is included on the University Risk Register.
- We are accredited to the Carbon Trust Standard.

Future plans

- Risk Register updated to include specific reference to Carbon and the Carbon Management Plan.
- Formal process of carbon assessment of policy/decision-making to be introduced – currently 50% of VCG (Vice-Chancellor's Group) are also members of the Carbon Management Board, but more formalised methods will be implemented and Carbon Management will be a regular agenda item at the University's senior management meetings.
- The Annual Planning process for all departments will include a carbon question highlighting the University's target.
- A formal heating and cooling policy will be formulated and enforcement of this will be necessary (eg. a standard approach to portable heating, and the installing of comfort cooling).
- Some job descriptions now include awareness of carbon issues.

Areas for further investigation include:

- Our investment appraisal process is currently being updated and could be modified to feature carbon.
- Research funding decisions – this may be harder but needs investigating.
- Departmental targets - it is planned to run a pilot programme to investigate incentivising departments by setting targets, charging for energy use, or sharing savings from improvements. A diverse organisation such as the University will possibly need a variety of approaches in different areas. The existing space charging process can be further improved – visibility of the breakdown of this is essential for departments to fully understand their energy costs.
- Introducing a more strategic approach to space management, and consideration of carbon in both day to day space management decisions and long term strategy. It will be essential to make sure the long term strategy is clear in all areas where possible.
- Timetabling - changes to the processes for central timetabling have already been made in terms of prioritising better controlled areas/buildings for out of hours bookings. There may be potential for further improvements in this area.

6.2 Responsibility – making it clear that saving CO_2 is everyone's job

Current situation

Our Big Energy Challenge - this treasury-funded project focussed on staff awareness-raising amongst the public sector within the Bath area and ended in June 2009. The momentum and visibility created from this project was significant, and generated clear savings through changes in behaviour but will need to be built on further in the future. The network of 55 Energy Champions recruited and trained across all departments in the previous year has been maintained as an essential resource.

Student residence competition – the energy-saving competition in student residences is now running for a fifth year. Student residence blocks compete against each other to win monthly prizes based on electricity used, and to win an overall prize of a celebratory meal and drinks. The results have again been very positive - for the campus accommodation as a whole the electricity use has been reduced by over 800,000kWh to date - a reduction of over 300 tonnes of CO_2. In 08/09 one off-campus residence, Canal Wharf, was 27% down on the previous year. Last year we teamed up with Student Switch Off, a national campaign that is running similar competitions at other Universities. They have enhanced our existing competition model by adding a better marketing/publicity angle, and are running Facebook sites, competitions and events for participating students – now called Eco Power Rangers.

Web pages – within the Estates' web pages a central point of reference has been further developed as a staff and student resource for all matters relating to Energy and Environment, as well as demonstrating our responsible approach to interested external parties (including prospective students). Features include background information, a 'What Can I Do?' section, regular internal news articles and links to relevant internal and external sites, including new dedicated pages developed by Accommodation and the Students Union.

Degrees Cooler - the University is one of 20 that have signed up to this programme, a DEFRA-funded project, that has 3 strands, the Student Switch Off, People & Planet's national Go Green an enhanced support for the student campaigning group, and thirdly Green Impact.

Green Impact - this is a departmental environmental accreditation scheme, based around an online workbook, which helps staff to change their behaviour within their workplace. In its first year we have already had over 40 teams/departments signed up to the process.

Student Union Sound Impact Awards - the Students Union achieved a 'Silver; award for Sustainability in this national scheme which looks at the SU and the University's performance across a wide range of environmental criteria on an annual basis.

Green Tourism - Accommodation & Hospitality Services achieved a 'Gold' award from the Green Tourism Business Scheme in both 2009 and 2010 for its operations. This is a similar scheme to the Sound Impact awards with a wide-ranging environmental audit across the whole range of its operations. The department is now working towards ISO 14001, the international standard for Environmental Management Systems.

British Paralympics Association – this team is basing its training camps leading up to the 2012 Olympics at the University. The BPA has a clear desire to reduce its environmental impact in general including at these camps and has been working with the sponsors EDF and the University to achieve this goal.

Future plans

- Continue with and expand Green Impact
- Continue with and improve the student residence competitions
- Include reference to/responsibility for carbon in job descriptions for future key roles (eg Technical Managers, Department Heads/deputies, Director of Computing Services)
- Investigate further the inclusion of a reference to carbon in relevant job descriptions of existing key staff , or potentially all staff via contracts of employment.
- Investigate further the merit of setting energy or carbon KPIs/targets for HoDs/Deans

A visible demonstration of leadership from the University's senior management will also be required, both in professional and personal behaviour.

6.3 Data Management – measuring the difference, measuring the benefit

Current situation

This is summarised in section 3.1.

Future plans

To overcome some of the limitations in data, especially in Scope 3 emissions, the following improvements are planned. There will always be some limitations in accuracy, assumptions required, and debates about what is included within the scope, however.

Scope 1		
Source	***Improvement***	***Comment***
Gas	None needed	
Oil	None needed	
Vehicle Fleet	Data handling and visibility may need improvement	
Refrigerant loss	To be discussed with servicing company	

Scope 2		
Source	***Improvement***	***Comment***
Electricity	None needed	

Scope 3		
Source	***Improvement***	***Comment***
Water	None needed	
Waste	Data for Contractor and construction waste to be fully captured, data handling and visibility to be improved	Could use own carbon conversion rates if waste compositions known
Student/staff commuting	Biennial travel surveys of staff/students plus annual vehicular surveys from now on, and will include current data from bus companies for numbers and emissions	Possibly to be cross-checked with parking permit information.

Business travel	New web-based expenses system will facilitate capture of some of the data	Travel insurance data can be used as a cross-check
	Use of new Travel Management Company data – this system is not currently used by all staff for travel arrangements but it is expected there will be greater coverage in future years	It is possible that this will need to be mandatory to ensure full accuracy.
Overseas student home trips	No improvement needed	Assumptions on the number of trips could be checked, but this raises the argument that any more than one return trip each year could be seen as holiday, which should not be included within the University's scope

Not all measures are numerical especially regarding embedding a carbon and/or sustainability culture, and so we will continue to engage in benchmarking processes such as Universities That Count to measure our performance.

6.4 Communication and Training – ensuring everyone is ready, willing and able

Current situation

Some of the current or past activities in this area have been highlighted in section 6.2. Others include:

- All new staff who attend the general University inductions view a video and receive summary information on energy-saving and sustainability
- As part of Our Big Energy Challenge we trained and mobilised 55 Energy Champions throughout all departments, trained 400+ other staff via face to face sessions or via a web-based tool, distributed awareness-raising materials, improved our communicating of energy information, and made a real step change in many people's everyday practices.
- Green Impact - many of the criteria in this are geared to improving the communication on sustainability issues within individual departments

Future plans

- Publicise new environmental policy and this Carbon Management Plan by developing a formal communications plan
- Review current central induction content and processes
- Review coverage of this central induction and individual departmental inductions, especially for certain groups (postgraduate students, casual staff) and review content and processes.
- Review Estates' web pages and create clearer interface
- Ensure regular news articles and case studies are written up and publicised
- Run an annual 'Green Week' in conjunction with student bodies
- Investigate inclusion of sustainability/carbon training within staff development training
- Include questions on attitudes to carbon & sustainability in the next Staff Survey in 2011 to inform behavioural change and communications strategies.
- Ensure that more high visibility improvements are made and well publicised within the University even if only small savings result (eg renewables projects, lighting improvements in key areas). This will help with motivation towards personal behavioural change due to a good example being set by the organisation.
- Sharing data – much energy data is currently shared via a variety of processes, but this will be improved, partly via Green Impact, but also through a specific project (CMP16 see section 4.4) to develop web-based information systems to allow open access to our monitoring data, in conjunction with display screens in key areas such as main foyers of buildings.

6.5 Procurement – engaging suppliers

Current situation

- We have a specific Environmental Sustainability Purchasing Policy (see http://www.bath.ac.uk/purchasing-services/staff.bho/sustainability/)
- In common with other HE institutions, Purchasing Services at the University of Bath has been undertaking a review of sustainable purchasing using the Flexible Framework from the HEFCE 'Procuring the Future' document, and has specific targets related to this.
- When evaluating tenders there is a weighting given to environmental criteria
- All commodity codes have a risk analysis that includes sustainability
- BREEAM (an ecodesign standard for buildings) is used routinely on all major capital building projects
- We have built 2 BREEAM 'Excellent' buildings already, and the new East building due to complete this year will also be to this standard.

Future plans

- Continue to use BREEAM, also add in specific Carbon targets aligned with best practice. As this standard is being made tougher year-on-year it will be built to a higher level of carbon efficiency than even these previous 2 projects, as will any future projects.
- All refurbishments to have Carbon assessments to ensure any opportunities are maximised
- Investigate using techniques/principles within Soft Landings framework to ensure smooth handover and commissioning of all major new projects
- Increase environmental weighting on high and medium relevancy tender evaluations from standard 5%, and/or introduce specific carbon weighting where relevant
- Investigate means of resolving the conflict between budget holders taking correct long term life cycle decisions for the University, versus annual budgeting cycles
- Advertise better to departments the availability of centralised funds (eg SALIX) to allow marginal cost differences of more efficient equipment to be met. Investigate creation of other central fund to ensure correct life cycle cost decisions made.
- Review Full Economic Costing of research processes to ensure energy and carbon costs fully included.
- Review University purchasing policies to ensure that, where deemed relevant, a full carbon impact assessment is carried out.
- Vehicle fleet upgrades – investigate alternative fuel vehicles where possible when replacing
- Investigate further development of a Low Carbon procurement strategy

6.6 Using the Estate as academic resource

This is a key area for future development that will help greatly with communication, but also brings many other benefits. The University's academic specialisms in both teaching and research have many synergies with the efforts (such as this Carbon Plan) to improve the operational sustainability of the organisation. The University Estate can potentially be a vital learning and research tool in many subject areas, to the benefit of all parties.

Some good collaborative work between Estates and academia is already happening, for example:

- We have recently been selected for Technology Strategy Board funding for intensive building performance evaluation, looking at the significant discrepancy between the predicted energy performance of a building, and hence its CO_2 emissions, and actual performance (collaboration with Department of Architecture & Civil Engineering)
- We have supported the installation of a DC electrical network in Library by the Department of Electronic & Electrical Engineering
- We have supported student projects in the Department of Chemical Engineering on water footprinting, the School of Management on carbon footprints, wind turbines etc
- Regular lectures for MSc in Environmental Design (Architecture)
- Membership of the Institute for Sustainable Energy & Environment (ISEE) Board

This area will be further investigated for development but for this to be maximised some specific resource may be necessary.

7 Programme Management of the CM Programme

The essential characteristics of good programme governance will be:

- Senior strategic ownership of the carbon reduction target
- Pulling together of diverse projects and improvements across the University
- Clear overview of the programme, encouraging successful delivery by identifying and removing blockages

This section sets out how this will be achieved.

7.1 The Programme Board – strategic ownership and oversight

A new Carbon Management Board was set up at the outset of this process. Its role was to oversee the preparation of this plan and it will remain in existence until July 2011. Its membership has been as follows:

- Deputy Vice-Chancellor
- Director of Finance
- Director of Estates
- University Secretary
- Head of Accommodation & Hospitality Services
- Lecturer in Corporate Social Responsibility (School of Management)
- Energy & Environment Manager

A review has taken place to consider what structure would best provide the necessary leadership and oversight on implementation of this plan, together with providing more effective support on other sustainability issues. It has been decided to create a new Sustainability and Carbon Management Steering Group, which will again be chaired by the Deputy Vice-Chancellor. It will have a different membership, reflecting the shift into an implementation phase as well as the broader remit. Whilst the Group will consider a range of sustainability issues, carbon management will be the most important. As the remit will also include transport, this will helpfully pave the way for the need to give very serious consideration to group 3 emissions. In respect of carbon management, the Steering Group will:

- champion and provide leadership on Carbon Management (CM)
- set and review strategic direction and targets
- own the scope of the CM Programme and prioritise carbon reduction projects
- monitor progress towards objectives and targets
- remove obstacles to successful completion of CM projects
- review and champion plans for financial provision of CM projects
- ensure there is a framework to co-ordinate projects in CM Programme
- act not just a committee but a driver of improvements

The Steering Group will meet quarterly and regular reports will be made on its work to the Vice-Chancellor's Group and Executive Committee. Periodic reports on the implementation of the carbon management plan will also be made to the University Council, and a publically-available report will be produced annually. The Steering Group willconsider reports from the Project leader including:

- Progress of projects
- Risks to major projects
- Risks to overall programme

The University is clear that the scale and importance of the task faced by universities in relation to carbon management is such that the main decisions on resource allocation should be taken by the Vice-Chancellor (or Council for the largest projects), as will any significant variations to the plan. The Vice-Chancellor will be kept abreast of implementation of this carbon management plan.'

7.2 The Carbon Management Team – delivering the projects

A Project Implementation Team is currently being planned within the Estates function, but this is subject to a potential restructure that is ongoing at the time of writing. It is clear that the current Energy Management Team within Estates will not be able to deliver all of these projects, but will deliver certain specific ones and provide input to all. A Project Implementation Team will be formed as a technical delivery team – this will meet every 2 months.

The other members of the existing Carbon Management Team from Finance, Students Union, Accommodation & Hospitality Services, Security, Sports, Purchasing, Office of the Vice-Chancellor, and Academic Assembly will meet for full update every 6 months.

7.3 Risk

There are a number of risks to this strategy, both on key projects and to the overall programme as summarised below, along with the mitigation in place to minimise this risk.

RISK	MITIGATION
Expansion of campus increasing absolute emissions	Have included some expansion in modelling. Have identified more savings than necessary to achieve target
Non-delivery of programme – technical reasons	Have assessed all projects as fully as possible and have reviewed with relevant technical staff Have identified more savings than necessary to achieve target
Non-delivery of programme – resource reasons	Have included Project Management costs within costings for relevant projects, hence can be managed internally or externally
Lack of finance to deliver programme	To be signed off by Finance Committee. Ensured purely financial justification of programme stands up well
Staff in key roles may leave	See Section 7.4 on succession planning
Carbon targets may increase	Have identified more savings than necessary to achieve target Have set target in line with overall sector target
No sign-off/buy-in to Plan	Carbon Management Board contains several key decision-makers within University Carbon Management Board kept briefed during development of Plan
Project Identification - incorrect assumptions (costs, savings, etc)	Have used conservative estimates for savings and costs, and included contingency costs on all key projects. Have used conservative assumptions on future utility price rises. Have used best available information from Carbon Trust and elsewhere.

7.4 Continuity planning for key roles

All aspects of the Department of Estates' operations are mindful of succession planning and other issues such as illness/sick leave and maternity leave, etc. Estates operate a flat management structure with regular management and senior management team meetings to disseminate information and co-ordinate projects and contractor's activities. Regular meetings are also held with other departments throughout the University and key stakeholders. Leadership and team working is a key part of the University's management protocol - we do not allow information and details to be in 'one person's head' giving rise to the single point of failure.

The Director of Estates (DoE) sits on the Executive and Finance Committees and in his absence the Deputy Director of Estates attends. The DoE also attends University Council and has fortnightly reviews with the Deputy Vice-Chancellor.

Estates have a medium to long term objective of achieving ISO 14001. Many of the processes and procedures in operation already comply with ISO 9001 although formal accreditation has not been applied for. Filing systems are common and document control consistent so any team member can pick up as required.

The University has a well developed and managed Risk Register, Emergency Management Plan and Team. Both these processes have identified the need to avoid single point of failure scenarios which are analysed constantly. There remains the issue of staff resigning and moving on but, as was demonstrated with the resignation of the Director of Estates in 2008, a replacement had already been interviewed before the previous Director had departed, and a formal appointment made within weeks.

The ability, experience and knowledge of key staff is immense and acknowledged but no one person is regarded as indispensible and planning revolves around this premise. Planning for events such as Swine Flu and other major events allows for the University to be closed but there is a procedure for giving key staff access the University network and systems by VPN.

The Director of Estates reports to the Vice-Chancellor. The University's Energy and Environment Manager reports to the Director of Estates, and in the absence of the Director, he would report to the Deputy Director.

The absence or loss of the University's Energy and Environment Manager and any member of his team would be a serious blow. However the situation would be managed depending on the cause. In the short term we would draw on external specialists in that field through the University's consultant framework which has access to suitably qualified and competent individuals from multi disciplinary practices such as Gifford, WSP and Hoare Lea. Consultants would be brought in on secondment and hourly rates for such eventualities have already been agreed. The situation depending on the term of absence would be managed accordingly.

If any replacement staff are required the authority to advertise and reappoint can be fast tracked through the Staff Vacancy Review Group (SVRG) who generally meet weekly, and is chaired by the Deputy Vice-Chancellor who also sits on the CMB.

This Plan also allows for a Project Implementation Team (PIT) for each and every project. The range of projects is diverse. The PIT provides for some existing Estates staff to be utilised but each project allows for appointing of specialists from our consultant framework to provide dedicated and concentrated inputs to project delivery. In respect of project delivery, our framework includes several firms of project managers with individuals which are already well experienced at working on this campus, with a knowledge of stakeholders, etc.

Throughout the term of the plan we shall continue to monitor and manage the issue of succession planning.

Appendix A: Carbon Management Matrix – Embedding

	POLICY	RESPONSIBILITY	DATA MANAGEMENT	COMMUNICATION & TRAINING	FINANCE & INVESTMENT	PROCUREMENT	MONITORING & EVALUATION
5 **BEST**	• SMART Targets signed off • Action plan contains clear goals & regular progress reviews • Strategy launched internally & to community	• CM is **full**-time responsibility of a **few** people • CM integrated in responsibilities of **senior** managers • VC support • Part of **all** job descriptions	• **Quarterly** collation of CO_2 emissions for all sources • Data **externally** verified • M&T in place for: ○ Buildings ○ Waste	• All staff & students given formalised CM: ○ Induction ○ Training Plan ○ Communications • CM matters **regularly** communicated to: ○ External community ○ Key partners	• **Granular** & **effective** financing mechanisms for CM projects • **Finance representation on CM Team** • **Robust** task management mechanism • **Ring-fenced fund** for carbon reduction initiatives	• **Senior** purchasers consult & adhere to ICLEI's **Procura+** manual & principles • Sustainability comprehensively integrated in **tendering** criteria • Whole life costing • Area-wide procurement	• Senior management review CM process • Core team regularly reviews CM progress • Published externally on website • Visible board level review
4	• SMART Targets **developed but not** implemented	• CM is **full**-time responsibility of an **individual** • CM integrated in to responsibilities of department **managers**, not all staff	• **Annual** collation of CO_2 emissions for: ○ Buildings ○ Transport ○ waste • Data **internally** reviewed	• All staff & students given CM: ○ **Induction** ○ Communications • CM communicated to: ○ External community ○ Key partners	• Regular financing for CM projects • **Some** external financing • **Sufficient** task management mechanism	• Environmental demands incorporated in tendering • Familiarity with **Procura+** • **Joint procuring** between HEIs or with LAs	• **Core** team **regularly** reviews CM progress: ○ Actions ○ Profile & Targets ○ New opportunities quantification
3	• **Draft** policy • Climate Change **reference**	• CM is **part**-time responsibility of a **few** people • CM responsibility of department champions	• **Collation** of CO_2 emissions for limited scope i.e. buildings only	• **Environmental / energy** group(s) give ad hoc: ○ Training ○ Communications	• **Ad hoc** financing for CM projects • Limited task management • No allocated resource	• **Whole life** costing occasionally employed • Some **pooling** of environmental expertise	• CM team review aspects including: ○ **Policies / Strategies** ○ Targets ○ Action Plans
2	• No policy • Climate Change **aspiration**	• CM is **part**-time responsibility of an **individual** • No departmental champions	• **No CO_2** emissions data compiled • Energy data compiled on a regular basis	• Regular poster/awareness campaigns • **Staff** given ad hoc CM: ○ Communications	• Ad hoc financing for CM **related** projects • Limited task coordination **resources**	• **Green** criteria occasionally considered • Products considered in **isolation**	• Ad hoc reviews of CM actions progress
1 **Worst**	• No policy • **No** Climate Change reference	• No CM responsibility designation	• Not compiled: ○ CO_2 emissions • Estimated billing	• No communication or training	• No internal financing or funding for CM related projects	• No Green consideration • No life cycle costing	• No CM monitoring

Self-assessment level - Summer 2010

Appendix B: Details of top 12 Projects

This appendix shows further details of the largest projects in the action plan (for simplicity, and because of the similarity of some projects, not all have been included).

In total these account for

- 81% of total capital spend
- 70% of all identified emissions

Project: **Reference:**	**Recommission main CHP (Phase 1 of district heating project)** ***CMP1***
Owner (person)	*Project Implementation Team*
Department	*Estates*
Description	*Recommission existing mothballed Deutz gas engine (1.3MWe) Combined Heat & Power plant with new waste heat recovery unit and new set up to avoid export of electricity*
Benefits	• *Financial savings: £246k p.a.* • *Payback period: 1.8 years* • *Emissions reduction: 1459 tonnes of* CO_2 • *31.9% of emissions target* • *NPV = £539k, IRR = 45.8%*
Funding	• *Project initial cost: £437k* • *Operational cost £8.4k p.a.* • *Source of funding: CMP*
Resources	• *Project management costs internalised*
Ensuring Success	• *Key success factors: rapid progressions to ensure timely use of summer shutdown for essential works, close management by Estates technical team* • *Principal risks: condition of mothballed unit is not fit for recommissioning insufficient internal resource to progress project, export situation unresolved, missed time window of summer shutdown,*
Measuring Success	• *Operation of CHP plant generating electricity with waste heat going to district heating network*
Timing	• *start date: summer shutdown June 2011* • *completion date: Oct 2011*
Notes	*This is a CHP plant installed in 1997. It ran until 2006 when a major breakdown on the heat exchanger led to a mothballing of the system due to several fundamental problems (poor exhaust design, lack of strategic thinking in the past, excess export of electricity). A major review of the system and district heating network has since taken place giving a strategic direction for the future, of which this is the first phase.*

Project: **Reference:**	**Convert DH to low temperature (Phase 2 of district heating project)** ***CMP2***
Owner (person)	*Project Implementation Team*
Department	*Estates*
Description	*Convert district heating system from high temperature system to low temperature with associated conversion of plant rooms*
Benefits	• *Financial savings: £143k p.a.* • *Payback period: 7.3 years* • *Emissions reduction: 762 tonnes of* CO_2 • *16.7% of target* • *NPV = £130k, IRR = 8%*
Funding	• *Project initial cost: £1,050k* • *Operational cost: £6.6k favourable p.a.* • *Source of funding: CMP*
Resources	• *Project management costs internalised*
Ensuring Success	• *Key success factors: advanced preparation to ensure timely use of summer shutdown for essential works, close management by Estates technical team* • *Principal risks: insufficient internal resource to progress project, missed time window of summer shutdown, technical problems in downstream plant highlighted, budgeted costs insufficient for all desirable works within plant rooms*
Measuring Success	• *Satisfactory operation of DH network at lower temperature*
Timing	• *completion date: Oct 2012*
Notes	*Several systems on University campuses like this were installed in the 1960s to operate at 140°C and above atmospheric pressure. Most have now been converted to run at a more standard 95°C to allow more of the waste heat from CHP systems to be reclaimed. Other benefits are lower heat losses, improved distribution efficiency, reduced pumping costs and lower maintenance costs. It will also lead to a more flexible system better able to cope with spring/autumn 'shoulder' seasons, a more reliable system due to less pressurised load on the network, and a system with more potential for future expansion.*

Project: **Reference:**	**Biomass boiler for STV** ***CMP4***
Owner (person)	*Project Implementation Team*
Department	*Estates*
Description	*Install packaged biomass boiler located in a containerised boiler house with integrated fuel store, to supply top-up and standby heat to Sports Training Village to integrate with existing CHP plant*
Benefits	• *Financial savings: £49.5k p.a.* • *Payback period: 4.7 years* • *Emissions reduction: 132 tonnes of* CO_2 • *2.9% of emissions target* • *NPV = £239k, IRR = 19.6%*
Funding	• *Project initial cost: £232k* • *Operational cost: -£43k favourable (including maintenance and RHI)* • *Source of funding: CMP*
Resources	• *Project management costs internalised*
Ensuring Success	• *Key success factors: Overcoming internal resistance to 'new' technology, ensuring good reliability equipment from reputable supplier* • *Principal risks: insufficient internal resource to progress project, lack of RHI, fuel supply costs, fuel quality, physical space for fuel storage & handling systems*
Measuring Success	• *Satisfactory operation of biomass plant*
Timing	• *start date: 2013*
Notes	*The introduction of the Renewable Heat Incentive (RHI) is financially crucial to this project (without this payment the payback would be 65 years). The current government have indicated this will go ahead June 2011 but at reduced rates to those originally proposed. The detailed feasibility study of this project should wait until the RHI is finally launched.*

Project: **Reference:**	**Biomass boiler for South buildings** ***CMP6***
Owner (person)	*Project Implementation Team*
Department	*Estates*
Description	*Install packaged biomass boiler located in a containerised boiler house with integrated fuel store, to supply year round heating demand of 3 South and 4 South buildings.*
Benefits	• *Financial savings: £77.7k p.a.* • *Payback period: 3.7 years* • *Emissions reduction: 216 tonnes of* CO_2 • *4.7% of emissions target* • *NPV = £452k, IRR = 26%*
Funding	• *Project initial cost: £286k* • *Operational cost: -£67k favourable (including maintenance and RHI)* • *Source of funding: CMP*
Resources	• *Project management costs internalised*
Ensuring Success	• *Key success factors: Overcoming internal resistance to 'new' technology, ensuring good reliability equipment from reputable supplier* • *Principal risks: insufficient internal resource to progress project, lack of RHI, fuel supply costs, fuel delivery issues, fuel quality, physical space for fuel storage & handling systems*
Measuring Success	• *Satisfactory operation of biomass plant*
Timing	• *start date: 2013*
Notes	*The introduction of the Renewable Heat Incentive (RHI) is financially crucial to this project (without this payment the payback would be 43 years). The current government have indicated this will go ahead June 2011 but at reduced rates to those originally proposed. The detailed feasibility study of this project should wait until the RHI is finally launched.*

Project: **Reference:**	**2 South server room upgrade and migrate departmental servers** ***CMP13***
Owner (person)	*Project Implementation Team*
Department	*Estates*
Description	*Upgrade existing server room, removing existing chiller system and installing water-cooled rear door solution or similar more efficient free-cooling option. This project also assumes that the existing inefficient server rooms in some individual departments will be shut down and the equipment moved to one of the main server rooms, also potentially making space available*
Benefits	• *Financial savings: £152k* • *Payback period: 6.4 years* • *Emissions reduction: 859 tonnes of* CO_2 • *18.8% of emissions target* • *NPV = -£49,809 , IRR = 5.1%*
Funding	• *Project initial cost: £978k* • *Source of funding: CMP*
Resources	• *Project management costs internalised*
Ensuring Success	• *Key success factors: clear brief and strategy from IT dept* • *Principal risks: insufficient internal resource to progress project (Estates and BUCS), over-estimates of existing departmental server room consumptions (lack of metered data), departmental resistance to server room migration, lack of physical space for new chilling plant.*
Measuring Success	• *Facility fully converted with new more efficient plant, plus 7 key server rooms migrated*
Timing	• *start date: 2012*
Notes	*IT data centres use large amounts of energy continuously, both to supply the servers, but also to cool the space. The Power Usage Efficiency (PUE) for a data centre is the ratio of total energy used to the energy use purely for IT, and the new server room has achieved a best in class PUE of 1.2. The existing 2 South facility has a PUE of around 2, i.e. of the ~£110k it costs to run, half is to cool the equipment alone.*

Project: **Reference:**	**STV Lighting improvements** ***CMP26***
Owner (person)	*Project Implementation Team*
Department	*Estates*
Description	*Redesign and replace the lighting and associated controls for the multipurpose halls, communal space and tennis halls.*
Benefits	• *Financial savings: £23,000 p.a.* • *Payback period: 6.5 years* • *CO_2 Emissions reduction: 135 tonnes of CO_2* • *2.9% of emissions target* • *NPV = £40k, IRR = 10.1%*
Funding	• *Project initial cost: £155,000* • *Operational cost £0* • *Source of funding: CMP*
Resources	• *Project management costs internalised*
Ensuring Success	• *Key success factors: good lighting system design and expert commissioning, the ability to integrate modifications into the existing emergency lighting system* • *Principal risks: restricted access to the areas due to building occupation times, insufficient internal resource to progress project*
Measuring Success	• *The Sports Training Village lighting is sub metered on the universities automated metering system, improvements can be measure as a reduction of energy usage by these meters.*
Timing	• *start date: June 2011* • *completion date :September 2011*
Notes	*Matching the known usage of the building to a more efficient lighting scheme is the key to the success of this project. This can be achieved by using more modern high efficiency fittings to replace the existing which are 8-15 years old, and through changes to lighting design. Controls need to be moved and incorporate automatic switching where required, to facilitate a more user friendly system.*

Project: **Reference:**	**Phase 2 Lighting Buildings common areas lighting upgrades** ***CMP30***
Owner (person)	*Project Implementation Team*
Department	*Estates*
Description	*Continue the rollout of lighting improvements mainly to common areas such as corridors, general teaching spaces etc. This project will follow on from the improvements made to the South buildings and STV and will include upgrading light fittings and adding automated controls according to the situation.*
Benefits	• *Financial savings: £38,000 pa* • *Payback period: 6.5 years* • *CO_2 Emissions reduction: 218 tonnes of CO_2* • *4.8% of target* • *NPV = £65k, IRR = 10.1%*
Funding	• *Project initial cost £250,000* • *Operational cost £0* • *Source of funding: CMP*
Resources	• *Project management costs internalised*
Ensuring Success	• *Key success factors: learning from the implementation of the previous lighting projects* • *Principal risks: insufficient internal resource to progress project, some areas may be affected by asbestos*
Measuring Success	• *Many of the buildings have sub meters so reductions can be measured directly.*
Timing	• *start date: June 2012* • *completion date: September 2012*
Notes	*Evaluation of exact areas of lighting improvements based on the previous lighting project will be carried out during the final part of 2011. Due to the rapidly improving design of lighting technologies, the original equipment evaluation may have to be altered to reflect which lighting system is superior. The choices are likely to be either T5 fittings or LED.*

Project: **Reference:**	**Metering improvements** ***CMP 43***
Owner (person)	*Phil Auger*
Department	*Estates*
Description	Metering improvements to fully sub meter the following areas: 2E, 8W, Wessex, 3W, 4E, 6E, 8E, M, N and H Subs, Boiler House, 2W, 1W, 1WN, and add these to our Automated Meter Reading (AMR) system.
Benefits	• *Financial savings: £ 26,000 pa* • *Payback period: 6.5 years* • *CO_2 Emissions reduction: 147 tonnes of CO_2* • *3.2% of target* • *NPV = £44k, IRR = 10.1%*
Funding	• *Project initial cost £168,750* • *Operational cost £0* • *Source of funding: CMP*
Resources	• *Project management costs internalised*
Ensuring Success	• *Key success factors: design of metering to measure actual loads using the correctly sized, type and make of meters; correct and careful installation.* • *Principal risks: insufficient internal resource to progress project, lack of building/supply downtime to fit the meters, age of the electrical equipment the meters are being fitted to.*
Measuring Success	• *Overall reduction in site electricity use*
Timing	• *start date: June 2013*
Notes	*The University of Bath has a very large and comprehensive existing metering system although there are key areas that are not fully metered. The metering of these areas is vital to the full understanding of the site consumption, to the analysis of the equipment to highlight problems, and for feedback to building occupiers to encourage behavioural change. Completion of the whole energy consumption picture will ensure that major energy wasted does not go undetected. Good quality metered data is vital in any energy reduction plan and has proved invaluable in the areas we have improved in recent years.*

Project: **Reference:**	***Fume cupboards – VAV system operation*** ***CMP51***
Owner (person)	*Project Implementation Team*
Department	*Estates*
Description	*Converting all Fume Cupboard extract systems to be Variable Air Volume (VAV) control systems. This system reduces the volume of air extracted through fume cupboards when the sash is lowered.*
Benefits	• *Financial savings: £51,197* • *Payback period: 7.8 years* • *CO_2 Emissions reduction: 287 tonnes of CO_2* • *6.3% of target* • *NPV= £18,545, IRR= 6.8%*
Funding	• *Project initial cost: £400,000* • *Operational cost: N/A* • *Source of funding: CMP*
Resources	• *Project will be delivered using current resources*
Ensuring Success	• *Key success factors: Close control of fume cupboard system operation parameters, change in typical usage patterns of behaviour* • *Principal risks: Ability to reconfigure present systems, limits of adjustment to maintain safe operation*
Measuring Success	• *Reduction in fume cupboard and laboratory make-up air energy demands*
Timing	• *start date: 2013*
Notes	*There are a number of diverse fume cupboard extract systems installed around the campus. A review of these systems is being undertaken to identify the individual system requirements for alteration to Variable Air Volume control. This will reduce the volume of extract air and also enabling the lowering of room make-up air volumes.*

Project: **Reference:**	***Freezers -80°C replacement*** ***CMP54***
Owner (person)	*Project Implementation Team*
Department	*Estates*
Description	*A number of older ultra-low temperature (-80°C) freezers will be replaced with newer more efficient models.*
Benefits	• *Financial savings: £27,927* • *Payback period: 8.1 years* • *CO_2 Emissions reduction: 158 tonnes of CO_2* • *3.53% of target* • *NPV= - £42,473, IRR= 1.6%*
Funding	• *Project initial cost: £225,000* • *Operational cost: N/A* • *Source of funding: CMP*
Resources	• *Project will be delivered using current resources*
Ensuring Success	• *Key success factors: choice of correct energy efficient replacement freezers* • *Principal risks: installing unnecessary or inefficient units, lack of buy-in from departments*
Measuring Success	• *Reduction in freezer energy us*
Timing	• *start date: 2011*
Notes	*There are a number of high energy consuming ultra-low temperature freezers distributed around the campus faculties. Replacing these older units with newer more energy efficient models will reduce the total energy used significantly.*

Project: **Reference:**	***Residences solar thermal*** ***CMP83***
Owner (person)	*Project Implementation Team*
Department	*Estates*
Description	*Installing solar thermal water heating systems to some south-facing roofs of residential blocks.*
Benefits	• *Financial savings: £25,335* • *Payback period: 9.13 years* • *CO_2 Emissions reduction: 27.6 tonnes of CO_2* • *0.6% of target* • *NPV= £7,224, IRR= 6.5%*
Funding	• *Project initial cost: £231,250* • *Operational cost:- £20,400 (i.e. positive saving including Renewable Heat Incentive payments)* • *Source of funding: CMP*
Resources	• *Project will be delivered using current resources*
Ensuring Success	• *Key success factors: correct sizing and integration of systems to maximise solar contribution to water heating* • *Principal risks: poor system performance due to incorrect integration with present heating system, reduced RHI payments*
Measuring Success	• *Reduction in water heating fuel demand in residential locations*
Timing	• *start date: 2012* • *completion date: 2013*
Notes	*There are a number of residential blocks on campus with gas fired water heating systems. Installing solar thermal systems will reduce the energy required to heat the domestic hot water. The solar water heaters utilise the incident solar radiation falling on the collectors to raise the stored water temperature. The output of the solar thermal system will be measured by a heat meter and RHI payments received for this output as well as the energy savings. This could also apply to some non-residential buildings which will be further investigated.*

Project: **Reference:**	***Residences solar PV*** ***CMP84***
Owner (person)	*Project Implementation Team*
Department	*Estates*
Description	*Installing solar photovoltaic (PV) systems to some south-facing roofs of residential blocks.*
Benefits	• *Financial savings: £26,776* • *Payback period: 13.3 years* • *CO_2 Emissions reduction: 40 tonnes of CO_2* • *0.9% of target* • *NPV=- £33,105, IRR= 5.0%*
Funding	• *Project initial cost: £355,000* • *Operational cost: - £19,698 (i.e. positive saving including Feed In Tariff payments)* • *Source of funding: CMP*
Resources	• *Project will be delivered using current resources*
Ensuring Success	• *Key success factors: correct siting and orientation of systems to maximise solar irradiation* • *Principal risks: poor siting and layout of PV array will reduce annual output, reduced FIT payments*
Measuring Success	• *Residential locations contributing to the site electrical demand*
Timing	• *start date: 2013* • *completion date: 2014*
Notes	*There are a number of campus residential blocks with south facing roofs. Installing solar PV systems will enable these blocks to generate a portion of their electricity requirements on site with very low carbon emissions. The output of the solar PV system will be measured by a meter and FIT payments received for this output as well as the energy savings. This could also apply to some non-residential buildings which will be further investigated.*