University of Bristol Carbon & Water Strategy – November 2017

In 2015 the University adopted a goal of being net zero carbon for Scope 1 & 2 emissions for buildings for which we have operational control, by 2030. These emissions almost exclusively result from the use of energy.

Getting to net zero carbon in a cost-effective manner is possible by reducing our consumption of energy per FTE, by using heat and electricity from zero-and low-carbon sources and by purchasing offset certificates.

This strategy details the activities we plan for the period to 2020/21, and the foundations for reaching our 2030 target. Also, we outline plans for improving control of Scope 3 emissions, and our targets for reducing them.

Although the carbon *mitigation* impact of water use is small, there is an increasing need to reduce our reliance on water resources to play our part in climate change *adaptation*, in an increasingly water-stressed world. We are therefore bringing our carbon and water strategies together, and aligning criteria for proving the cost-effectiveness of conservation and efficiency measures

Aim

This strategy's aim is to undertake works in the period 2020/1 to put the University on the lowest-cost path to:

- Becoming carbon neutral on Scope 1 & 2 emissions from buildings by 2030.
- Comprehensively measuring and reducing Scope 3 emissions by 2020/1
- Capping water consumption at 2016/17 levels

Scope

The Scope is defined by our ISO14064 Standard, which we have held for six years to 2017, and that is the standard by which success will be measured. This covers all buildings and activities covered by our group level financial report. We will be able to work most cost-effectively on buildings over which we have operational control, which currently account for 94% of our Scope 1 & 2 emissions. However, we will also work with the organisations which provide us with additional space, to drive consumption and emissions down there too.

Objectives

- To continue to use ISO 14064 Scopes 1 & 2, externally audited, to measure our carbon emissions.
- To put the University on a path to Zero Carbon by 2030 and to reducing energy consumption per staff and student FTE by 12% by 2020/21 and a third by 2030
- To monitor water consumption of a per building basis and implement conservation and efficiency measures, beginning with the highest -consuming buildings.
- To undertake these in the most cost-effective manner possible whilst providing all necessary energy and water services to staff and students
- To provided educational and research opportunities to staff and students as we undertake this work
- To use new technologies as they emerge to serve our aims in the most cost-effective manner possible

Targets

- To cap grid electricity use at 68.5GWh, the 2015/16 total, by 2020/1, to ensure that we are not placing additional pressure on the grid as it decarbonises. This will also protect us against the high prices rises expected for this commodity. We will meet this target by efficiency and self-generation.
- To cap grid gas use at 83.5GWh, the total for 2014/15 which was an averagely warm year, by 2020/1 to ensure that we are not placing additional pressure on the grid as it decarbonises. We meet this target by efficiency, the use of district heat and using renewable heat. This will depend on the availability of district heat.
- To reduce kWh use from grid gas and electricity per staff and student FTE by a third, from 5,800kWh/FTE to 3,900kWh/FTE by 2030, and thus 12% to 5,100kWh by the end of 2020/21
- To cap water consumption at 2016/17 levels to 2020/21 in the face of increasing staff and student numbers.

Actions

The tools we have available for these are as follows. in order of cost-effectiveness, the most cost-effective first:

1. Optimising our use of space
2. Conserving energy and water
3. Using energy and water more efficiently
4. Building new buildings to the highest cost-effective energy standards

These will halve our emissions by 2030 and cap water consumption with no other intervention

5. Using self-generated heat and electricity from lower-carbon sources to save 5%
6. Using local externally generated heat and electricity from lower-carbon sources to save 20%
7. Using mains gas and electricity from lower-carbon sources to save 20%
8. Certificating the offset of residual to save 5%

Measures 1-4 will have paybacks of less than seven years and relate to activity undertaken by the Estates office in the normal run of events or under the carbon management plan. With changes to the electricity grid, we will expect our absolute carbon emissions to fall by 12% by 2020/1 and halve by 2030.

Measures 5 and 6 will have longer paybacks but will be cost effective in the longer term.

Measures 7 and 8 are likely to have a positive cost to the University, but these costs will be reduced by applying measures 1 to 6. Overall, we expect getting to zero to be broadly cost neutral by 2030.

Progress to date

Up to the end of the financial year 2016/7 we have spent £9.0m on the previous carbon management plan, yielding cash savings of £1.6m a year against business as usual. Progress on reducing emissions is as follows:

	2005/6	2015/6	
Staff FTE	4,745	5,781	22%
Student FTE	15,347	20,365	33%
GIA	352,500	489,350	39%
Grid Electricity Consumption GWh	64.3	68.5	6%
Grid Gas Consumption GWh	83.5	75.0	-10%
Income (£m)	286.0	486.0	70%
Income (£m) Inflation corrected	391.8	553.6	41%
Scope 1 & 2 Emissions (tCO2e)	46,499	42,466	-9%
kWh Grid Elec & Gas per FTE	7,358	5,488	-25%
Emissions/FTE (tCO2e)	2.3	1.6	-30%
Emissions kgCO2e/m2	132	87	-34%
Emissions tCO2e/£m inflation corrected	119	77	-35%

Water consumption 07/08 to present

The cost of water and sewerage services to the University of Bristol is £900k a year. We have already made great inroads in water consumption, largely through updating infrastructure and resolving long-standing leaks, and despite a growth of a third in the number of FTEs and area served since 2007/8, consumption has reduced by 28% to 352,000m^2 a year.

Year	m3	Variation	
07/08	491,473	0%	
08/09	448,713	-9%	
09/10	445,265	-9%	
10/11	448,161	-9%	
11/12	416,403	-15%	
12/13	367,037	-25%	
13/14	379,022	-23%	
14/15	384,067	-22%	
15/16	354,425	-28%	
16/17	352,111	-28%	Provisional

Roughly half of all water is used by residences, and half by academic and administration buildings.

University of Bristol Carbon & Water Strategy

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1. Progress to Date & Plans for the Future

1.1 Background

This is a Sept 2017 update on the University's 2010 Carbon Management Plan and its Mar 2013 update.

The main drivers for an update are:

- In 2015 the University has adopted an aspiration of being zero carbon for Scope 1 & 2 emissions[1] by 2030.
- We have made great progress in energy efficiency and renewable energy since 2010
- The University has grown strongly since then, and there are plans for further growth
- Energy-saving technologies are maturing rapidly, particularly in the field of control
- The carbon intensity of electricity is reducing rapidly. The carbon intensity of gas is broadly constant. However, the cost of electricity is projected to increase much faster than the cost of gas.
- Although we can demonstrate that our Scope 1 & 2 emissions are well characterized and managed, we need to do more about our Scope 3 emissions, and provide a framework for managing these better.

In 2010, HEFCE "Carbon Reduction Target and Strategy for Higher Education in England"[2], set a sectoral target to reduce Scope 1 & 2 emissions by 34% by 2020 against 1990, a 48% reduction on a 2005/6 baseline.

The University pledged to play as full a role as possible in contributing to reaching the sector's targets and committed to spend £20m in that period on carbon reduction activity. Our original plan called for a reduction of 38% on 2005/6 by 2020/1 with a milestone of 15% in 2015/16, predicated on zero growth.

The plan, and its successors, was produced to ensure:

- That we have a response to the requirements of HEFCE's Capital Investment Framework
- We are seen to fulfil our moral obligation to act on Climate Change
- That the University plays its part in achieving HEFCE's national sector targets
- That we have a tool to reduce its exposure to volatile energy markets and to energy levies
- That carbon is considered at the earliest planning stages of new buildings, refurbishment and procurement, when mitigation can be implemented most cost effectively.
- That we have a framework for considering carbon emissions outside our direct control

[1] Scope 1 & 2 emissions are from owned transport, boilers and the generation of purchased electricity. Scope 3 emissions are those indirect emissions that occur as a consequence of the activities of our organisation, but which are not owned or controlled by us. The staff and student commute is an example of Scope 3 emissions.
[2] HEFCE – January 2010/01 section 23

The University of Bristol's carbon emissions in 1990 were reported[3] to be 25,513tCO_2 and we calculate that our Scope 1 & 2 emissions in 2005/6 were 46,499 tonnes. The basis for the preparation of the 1990 figure has been lost, so we have a much higher level of confidence in the 2005 figure.

Up to the end of the financial year 2016/7 we have spent £9.0m on the carbon management plan. This yields cash savings of £1.6m a year against business as usual. Progress on reducing emissions to date is as follows:

	2005/6	2015/6	
Staff FTE	4,745	5,781	22%
Student FTE	15,347	20,365	33%
GIA	352,500	489,350	39%
Grid Electricity Consumption GWh	64.3	68.5	6%
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Emissions kgCO2e/m2	132	87	-34%
Emissions tCO2e/£m inflation corrected	119	77	-35%

Though the headline reduction of Scope 1 & 2 emissions is 4,000 tonnes, as above, around 6,200 tCO2e a year have been saved, a 13% reduction due to the Carbon Management Plan. This has been measured by looking at consumption at the pre-2009 set of buildings. Growth in consumption has occurred at the National Composite Centre, Life Sciences and our High-Performance Computing facilities. Reductions outside our activities have occurred through consolidation of Hospital buildings and in the reduction in the carbon intensity of electricity.

1.2 Plans for the next four years and for 2030

In 2015, the University has adopted an aspiration of being net zero carbon for Scope 1 & 2 emissions by 2030.

This means that we aim to have net zero emissions from buildings in which we can make changes to the fabric and operation of the building, and where we pay a bill for the gas, electricity or heat that we use. We will work with providers of hospital space and leased residences, for which heat and power costs are included in a space charge, to reduce and offset emissions there.

Over the period to 2020/1, and on to 2030 we are currently expecting more growth at an annualised rate of over 4-5% a year in student numbers. This will require an increase in space, most significantly a development of approximately 82,350m2 at Temple Quarter. This development alone represents a 15% increase in our gross internal area. It will therefore be imperative that carbon neutrality can be achieved by 2030 at this site.

[3] SQW Energy "Carbon baselines for Individual Higher Education Institutions in England" Draft January 2010.

1.3 ISO 14064-1:2006

The University measures its carbon inventory under ISO 14064, which specifies principles and requirements at the organization level for quantification and reporting of greenhouse gas (GHG) emissions and removals. It includes requirements for the design, development, management, reporting and verification of an organization's GHG inventory.

All measurements in this strategy will be to this standard.

2. Factors Affecting Carbon Reduction between 2017/18 and 2030

Scope 1 & 2 carbon emissions from the areas over which the University has operational control come mainly from the use of gas and electricity, with less than 2% coming from the use of oil, owned or leased vehicles and fugitive greenhouse gas emissions from refrigeration.

Of these, around 65% of emissions came from the use of electricity, and 35% from the use of gas.

Over the last few years, the cost of electricity has been around three times that of gas, and the amount of carbon emitted by electricity has been just under three times that of gas.

However, electricity is decarbonising quickly, and some projections suggest it may fall from the region of 450gCO2/kWh to 100gCO2/kWh by 2030. It could therefore be as low as 300g/kWh by 2020 and 220g/kWh by 2023, compared with gas at 184g/kWh. With electricity at 100g/kWh, assuming our present consumption, our emissions would halve by 2030, with 65% of emissions coming from gas and 35% from electricity.

To pay for the investment in low-carbon infrastructure required, electricity prices are subject to an increasing number of levies, which are redirected through the industry to support individual projects.

Tools for Reducing Our Carbon emission to Zero

The tools we have in order get to zero carbon are:

1. Optimising our use of space
2. Conserving energy
3. Using energy more efficiently
4. Building new buildings to the highest cost-effective energy standards

These will halve our emissions by 2030 with no other intervention

5. Using self-generated heat and electricity from lower-carbon sources to save 5%
6. Using local externally generated heat and electricity from lower-carbon sources to save 20%
7. Using mains gas and electricity from lower-carbon sources to save 20%
8. Certificating the offset of residual to save 5%

Measures 1-4 will have paybacks of less than seven years and relate to activity undertaken by the Estates office in the normal run of events or under the Carbon Strategy.

Measures 5 and 6 will have longer paybacks but will be cost effective in the longer term.

Measures 7 and 8 are likely to have a positive cost to the University, but these costs will be reduced by applying measures 1 to 6.

To decarbonise in the most cost-effective manner possible, cost-neutrally or better, we must therefore, decrease our consumption of gas and electricity to support for longer-payback measures, or measures like certification which will have a positive cost.

3. Carbon Management Strategy

We propose a Carbon Strategy to reduce net Scope 1 & 2 carbon emissions from buildings to zero by 2030.

Most of these emissions arise from the use of electricity and gas, so we will do this by:

- Optimising our use of space
- Conserving energy
- Using energy more efficiently
- Building new buildings to the highest cost-effective energy standards
- Using self-generated heat and electricity from lower-carbon sources
- Using local externally generated heat and electricity from lower-carbon sources
- Using mains gas and electricity from lower-carbon sources
- Certificating the offset of residual

3.1 Optimising our use of space

We will aim to reduce the use of space required per FTE in accordance with the Space Utilization Strategy[4] which will aim to make more economic use of space where is can be done in a manner consistent with improving the staff and student experience.

Using space more efficiently will have the effect of reducing the energy services used per FTE.

3.2 Conserving energy

Energy is conserved when energy is not used when it is not needed. Examples include lighting controls which switch off lights or heaters or using thermostats to limit space temperatures. Behavioural changes, such as switch off equipment when they go home at night, fall into this definition.

An innovation in this area is the use of automatic controls which communicate data on building states between systems. For example, sensors on lights in a building could show whether the building is empty and send data to the heating system to reduce temperatures and ventilation rates. The University is active in research in such interoperable controls so there is scope to use the Estate as a living laboratory as more of these are developed.

3.3 Using energy more efficiently

Energy is used more efficiently when the same amount of light, heat, power or other service is provided using smaller amounts of energy. Key technologies include the installation of low energy LED lighting, installing more efficient burners in boilers, or replacing less efficient refrigerators with newer, more efficient models.

[4] The Space Utilization Strategy xxxxxxxxxxxxxxxxxxxx

3.4 Building new buildings to the highest cost-effective energy standards

We will aim to build new buildings to the highest cost-effective energy standards, using whole-life costing methodology to underpin this. New buildings represent an opportunity to think innovatively about energy as a service from first principles, and provide the heat, power and light required using the most modern technologies for provision and control. This may increase the build cost of some buildings, with an attendant many-fold saving over the life of the building.

3.5 Using self-generated heat and electricity from lower-carbon sources

The key technologies here are:

Combined heat and power (CHP) – in CHP, gas feeds an engine, from which secondary heat can be recovered and used to heat buildings, and provides electricity via a generator. The University already uses CHP at 4 sites, though the three largest of these units will come to the end of their working lives around 2020. We will need to determine whether to replace these. They typically have a payback of around 7 years.

Solar electricity – this is a good technology for urban sites, and availability of electricity fits well with summer demand from cooling and air conditioning. However, as there are several safety issues which must be addressed when mounting panels on roofs. The best solution would be a large-scale solar farm at Langford, if land could be released from agricultural, research and teaching requirements. We already have half a megawatt of solar power, but this only supplies less than 1% of our electricity. The technology currently has a payback of 9-10 years, though equipment prices continue to fall and electricity prices continue to rise.

Air Source Heat Pumps – these are used in refrigerators: heat is removed from the cabinet by a heat pump and rejected through the coils at the back. Air source heat pumps can extract heat from ambient air and use it to heat water or air on a scale large enough to provide heat for a building. They use electricity to run, but for every unit of electricity used by a heat pump, three units of heat are made available. We have been using these to provide hot water at residences, replacing immersion heaters. There they have had a payback of six years. As electricity decarbonises, this will offer a very low carbon source of heat.

Other technologies that are available are:

Wind: They University has surveyed all its sites and has none at which wind power could be used economically.

Biomass: We have significant concerns about the use of biomass. In the urban context, it can impair air quality both from emissions but also from number of fuel deliveries it requires to displace any significant quantity of gas [ref]. Also, there is increasing concern about the sustainability of sourcing wood fuel [ref].

3.6 Using local externally generated heat and electricity from lower-carbon sources

As of July 2017, the University is working with Bristol City Council (BCC) and University of Bristol Hospitals Foundation Trust (UBHFT) to identify ways in which secondary heat from a new gas fed CHP at the hospital could be used to heat University buildings.

BCC have some heat networks of this kind already in place, and plans for more. Eventually, these small networks could be brought together and fed from secondary heat from industrial processes in Avonmouth. In this way, gas-fed CHP could be a precursor to a truly zero-carbon heat network.

3.7 Using mains gas and electricity from lower-carbon sources

It is possible to buy gas and electricity from the grid from low carbon sources, which can even be specified, at a premium. Under ISO 14064, this is allowable as a carbon reduction measure. We have started to buy 100% renewable energy since 1st April 2017 backed by Renewable Energy Guarantees of Origin (REGOs). This costs an additional £22k a year on an £6m electricity spend.

Gas from green sources, such as anaerobic digestion, is also available, but costs a lot more: it would currently add around £235k to our £2m gas spend. However, we might wish to explore this, with the caveat that we should reduce consumption as much as possible first to limit additional spend on lower carbon fuels.

3.8 Certificating the offset of residual

Certification is commonly known as "carbon offsetting", in which other individuals or organisations around the world around the world are paid to implement measures to reduce carbon. Measures might include: protecting or expanding forests; helping people in developing countries to access efficient stoves that use less firewood; paying for renewable generation to supplement electricity supplies where diesel generators are currently used.

There is scepticism of these schemes as it is difficult to demonstrate additionality – are they really making a difference? However, there are several audit standards that give assurance of their quality and value.

Particularly, the Clean Development Mechanism (CDM) is a "Flexible Mechanisms" defined in the Kyoto Protocol [ref] that allows emissions reduction projects to generate Certified Emission Reduction units (CERs) which may be traded in emissions trading schemes.

For situations where there is no low-carbon alternative available, offsetting may be the only route.

Unlike efficiency and conservation measures, offsetting would be a net positive cost to the university.

3.8 Scope 3 Emissions

Scope 3 emissions are those indirect emissions that occur because of our activities, but which are not owned or controlled by us. These can vary from commuter travel to the carbon consequences of food miles or the carbon footprint for a stationery supply.

We will continue to monitor these through the ISO 14064 process to baseline our Scope 3 emissions and engage with staff, students, suppliers and other stakeholders to reduce them.

4. Implementation

We propose the following for reducing Scope 1 & 2 emissions from areas where we have operational control.

4.1 The Current Situation

In 2015/16 emitted 1.6tCO_2e Scope 1 and 2 per staff and student FTE.

- 98% of this came from the combustion of 75.4GWh of grid gas, and the use of 68.5GWh of grid electricity, totalling 143.9GWh of fuel. Staff and student FTE in 2015/16 was 26,146.
- By end use, including self-generation using gas-fed CHP and solar power, and including losses we used 68GWh of electricity and 60GWh of heat in 2015
- About 40% all energy was used in the 5% of space which is highly serviced space, typically comprising laboratories and server rooms, with high levels of heating, air handling, cooling and humidification.
- Residences represent 20% of the total.
- Across all types of estate, lighting is estimated to consume 20% of all electricity.

4.2 By 2030 we aim to:

- Use space optimisation, energy efficiency and conservation measures, advanced control and self-generation to reduce grid energy consumption per staff and student FTE by 30%, from 5,800kWh to 3,900kWh by 2030. This is a 2.5% reduction a year and 12%, to 5100kWh/FTE by 2020/21.
- Halve the amount of heat and electricity used by highly-serviced laboratory spaces by space optimisation and the use of better control of air handling
- Reduce the amount of electricity used by lighting by using LED lighting and controls in all situations
- Reduce the energy consumption by office accommodation by 10%
- Have every university vehicle an electric or hybrid vehicle

Where practical and cost-neutral or better to do so we will:

- Use district heat from low-carbon sources to replace gas or electric heat wherever it is available in anticipation of a city-wide grid using rejected industrial heat.
- Continue to use CHP, moving to biogas as a fuel by 2030
- Install air source heat pumps, in anticipation of a rapidly decarbonising electricity supply
- Use well-controlled direct electrical heating where the
- Install solar panels for electricity, where practical

We will use:

- Electricity from renewable contracts from now on
- Gas from renewable sources increasing by 10% a year from 2018/19
- Carbon offsetting to offset fugitive emissions.

4.3 Steps to 2020/1

The next steps we need to achieve to be on a path consistent with meeting our 2030 goals are as follows

4.3.1 Space Optimisation

We will use space more efficiently by implementing the Space Utilisation Strategy, and by the implementation of agile working practises.

4.3.2 Space Heating and Cooling

We will agree a heating and cooling policy to manage expectations of temperatures in office environments

4.3.3 Small Works - Energy Efficiency and Conservation Measures

We will invest in measures to address specific energy issues as they arise. This will have a value of £300k/year. We have conservatively estimated that these projects will have a mean payback time of 5 years, saving a cumulative £60k a year. Projects could include better insulation; improvements to heating plant; better control of air-conditioning; the incorporation of variable speed drives into ventilation systems.

The Energy Manager and BMS Manager will continue to operate a housekeeping programme to ensure heating, ventilation and air conditioning systems are working optimally, and that the CHP units on the Precinct and at Langford are always running when it is carbon- and cost-effective to do so.

We will undertake projects to reduce exposure to non-commodity charges out of this fund.

Total cost over 4 years: £1.2m

Simple payback time across all projects: 5 years

Annual cost saving by 2020 £240k

Minimum energy saving by 2020: 2.4GWh

4.3.4 Control

The University has several major buildings[5] which are controlled Satchwell building management system. Most of our buildings use Trend. This is an older system for which support has becoming difficult to source. Whilst not an energy saving measure *per se*, replacing Satchwell with Trend in these buildings would aid resilience,

[5] Biomedical Sciences, Merchant Venturers, Queens, Drama, Coombe Dingle and several smaller sites. Together they use around a quarter of our energy

remove barriers to energy efficiency measures and achieve benefits in management from greater commonality between systems. The cost for this replacement would be £600k

Total cost over 4 years: £600K

Simple payback time across all projects: Not applicable

4.3.5 Energy Efficiency in Highly Serviced Laboratories

Analysis suggests that highly serviced space – typically laboratories with a large throughput of conditioned air – is responsible 40% of our energy use.

We will continue our current £980k programme, of which £330k has already been committed, to include:

- Improvements to air handling in laboratories
- Top up grants for teams replacing inefficient freezers to buy the most energy efficient models
- Replacement of direct-to-drain water cooling with electric chilling

Total cost over 4 years: £650k, already agreed

Simple payback time across all projects: 4 years

Annual cost saving by 2020 £163k

Minimum energy saving by 2020: 2.3GWh

4.3.6 Monitoring and Targeting

The University will continue its roll-out of half-hourly metering to better understand the energy profile of our buildings. These help identify when equipment has been left on unnecessarily out of hours, and help gauge the effectiveness of energy saving measures. Where possible we will use this data to raise awareness of issues

Non staff costs over four years: £40k, paid for from Small Works

4.3.7 Lighting

We will continue to install advanced lighting with appropriate controls wherever paybacks are less than seven years. This will continue spending against a budget of £3.0 m of which almost £1.0m has already been spent.

Total cost over 4 years: £2m, already agreed

Simple payback time across all projects: 7 years

Annual cost saving by 2020 £285k

Minimum energy saving by 2020: 1.9GWh

4.3.8 Reburnering

We will continue to replace old burners in boilers with new networked ones capable of burning efficiently over a range of outputs. We have £185k left in budget for sites where we can save at less than a seven year payback.

Total cost over 4 years: £185k, already agreed

Simple payback time across all projects: 7 years

Annual cost saving by 2020 £26k

Minimum energy saving by 2020: 1.0GWh

4.3.9 Renewables

£350k is available from previously-agreed capital budgets for renewables at electrically-heated halls. We have also £650k agreed for spending on heat pumps or solar panels.

We will replace electrical immersion heat, or even gas, wherever practical and with a sub 6-year payback, with air-source heat pumps. We will implement solar electricity wherever practical with a ten-year payback or less.

We may use some of this budget to make buildings ready to receive low-carbon district heat where available.

The most cost-effective way to install solar is mounting directly on the ground. We are looking for sites for this.

Total cost over 4 years: £730k, already agreed

Simple payback time across all projects: 7 years

Annual cost saving by 2020 £100k

Minimum energy saving by 2020: 1.0GWh

4.3.10 Combined Heat and Power

We use CHP at Chemistry, Medical, Langford and Richmond Building, which provide 8% each of our electricity and heat. Chemistry, Medical and Langford will reach end of life around 2020. We will optimise their production until they are retired.

Gas for CHP is now available from renewable sources, under standard contracts, at a premium, so this could be a route to providing zero carbon electricity and heat. The widening spread between gas and electricity prices, is increasing the viability of CHP schemes. CHP units are becoming increasingly reliable and efficient, and we would be able to contractually require better performance than we have experienced with the current units.

The competing technology may be the availability of district heat. We will take a decision on the desirability of replacing CHP against using a district heat network in early 2018 when it will be clearer how much district heat will become available in the area in the next few years.

We have demonstrated that there is a case for CHP at the Wills Hall Residence. The requirement for heat production there matches electrical heating demand at Badock and Hiatt Baker, an ideal situation for CHP.

Total cost to replace Chemistry, Medical and Langford: £2.9m – we will bid from capital funds when we have identified the best way forward.

Cost to install CHP at Wills Hall, approx. £600k. We will bid from funds when we have built a definitive case.

4.3.11 District Heat

The University is working with Bristol City Council, and UBHFT, the local hospital trust, to look at ways in which district heat from low-carbon sources can be used. The City Council has a vision for developing a series of district heat networks at different localities in the city. This has the aim of, within the next ten to fifteen years, joining them together to use heat from a heat main bringing waste heat from industrial processes at Avonmouth into the city centre.

Plans are well advanced: we are currently expecting to implement the first connection before September 2018, and it is expected that the Second Campus buildings will also be connected to a district heat main.

Total cost over 4 years: £100k, yet to be agreed

Simple payback time across all projects: 2 years

Annual cost saving by 2020 £60k

Minimum energy saving by 2020: N/A

4.3.12 Electricity Storage

Although not a carbon saving measure, installing electrical storage helps the National Grid to balance supply and demand when there is a high proportion of variable renewable electricity on the grid. We are looking into the possibility of installing our own storage to help the grid, paid for from the receipt of balancing fees.

Storage at Langford could help balance variable outputs from CHP, solar and diesel generation in order to present a profile which is beneficial for the grid. We are also looking at the risks and benefits of doing the same on the Precinct.

Total cost over 4 years: £1m, yet to be agreed

Simple payback time across all projects: 5 years

Annual cost saving by 2020 £200k

Minimum energy saving by 2020: N/A

4.3.13 Offsets and Certification

We will investigate the most cost-effective and carbon effective methodologies for reducing the carbon impact of the electricity and gas that we buy, through power purchase agreements, audited green tariffs and certificated biogas, but also by exploring offsetting mechanisms that adhere to international standards.

5. Scope 1 & 2 emissions from sites and activities over which we have no overall control

For leased residences and hospital spaces where we do not have operational control, we will continue to "claim" this CO_2 as our own under the ISO 14064 process, but also work with the space providers to reduce the carbon intensity of the space.

6.0 Scope 3 Emissions:

Scope 3 emissions are those indirect emissions that occur as a consequence of the activities of our organisation, but which are not owned or controlled by us. These can vary from commuter travel to the carbon consequences of food miles or the carbon footprint for a stationery supply.

The estimated baseline figures for the University's Scope 3 emissions, are, with key areas in bold:

	Emissions (tCO2e)		Source
Procurement	**Construction**	**14,774**	SUPC model based on spend in each area, 2015-16
	Food and catering	**9,653**	
	Other products	8,849	
	Business services	7,621	
	Paper products	6,558	
	Other procurement	4,273	
	IT & Comms tech	2,726	
	Med & precision tech	1,597	
	Fuel chemicals & glass	628	
	Total	**56,680**	
Staff and Student Travel for Business	**Flights**	**7,216**	From ISO14064 return 15-16 (externally audited)
	Bus	26	
	Ferry	1	
	Train	368	
	Taxi	14	
	University Bus	77	
	Mileage	275	
	Total 7,977		
Staff and Student Daily Commute	**Staff commute**	**2,940**	Estimate from 2009. We will revisit this in 17/18
	Student Commute	**357**	
Termly Student Travel	**14,900**		Estimate from 2006/7. This is dominated by air travel, and does not contain the effect of radiative forcing. We will revisit this in 17/18
Waste	Zero (no waste to landfill)		From ISO14064 return 15-16 (externally audited)
Water	336		From ISO14064 return 15-16 (externally audited)

The challenge of Scope 3 is to assess the magnitude of each component. Unlike Scope 1 and 2 emissions, Scope 3 emissions must be estimated indirectly from proxy measures. This makes it difficult to do more than to prioritise areas for action, and it can obscure the effect of mitigating activity.

However, we have established a baseline for Scope 3 activity of 83,190tCO2e and set targets for reducing it.

We aim to:

- **Do further work refine the 83,190tCO2e figure**
- **Reduce this relative figure of 150tCO2e per £1m spend by 10% between 2017/18 and 2022/23**

Key areas for reducing emissions are therefore:

- **Construction** – using the pre-existing BREEAM process
- **Food & Catering** – using current internal policies to favour local produce and reduce waste
- **Business Flights** – by promoting alternatives such as video conferencing
- **Staff and student commute** – via the current Staff and Student Travel Plans
- **Termly Travel** – this is difficult to influence, but it is so large that we need to investigate how communications could help students make low carbon choices.
- We are reducing the impact of our procurement of **other products** through Sustainable Procurement policies and supplier engagement.

It can be seen that some aspects are quite rigorously measured via the ISO 14064 process, but other quantities, such as staff and student travel, rely on sampled data and are therefore less accurate. The sum of these is 83,190 tonnes. Our turnover in 15/16 was £553.6m, so our Scope 3 emissions are 150tCO2e per £1m of spend.

Scope 3 emissions from procurement have been estimated to be 56,680tCO2e for 15/16, via a Southern Universities Purchasing Consortium (SUPC) method. This assigns weightings to spend in different areas from a set of DEFRA co-efficients which are in turn estimates of carbon intensity of various sectors of the economy.

The problem arises that, using this method, higher prices inevitably lead to an apparent increase in emissions. For example, if engagement with suppliers leads to an item of equipment having a higher price but lower footprint when measured by a process such as PAS 2050[6], this would not be reflected by the DEFRA/SUPC methodology. The categories are also quite wide – "paper goods" includes books, which may nowadays include subscriptions to e-journals. Also, the relatively high price of short-run academic books compared with long-run popular books makes them more expensive, and pushes their apparent footprint higher.

6.1 Procurement

[6] PAS 2050 is a method for assessing the lifecycle carbon emissions of a product

Sustainable procurement practices can ensure the purchasing of the most energy efficient equipment, and the Head of Sustainability will be working closely with the Head of Procurement to implement good practice here. ICT is likely to be an early area for investigation with this approach.

6.2 Transport

We have been working with Procurement and Finance to provide firmer data on business travel and travel undertaken by staff members in their own cars. We are also working on surveys to provide more robust estimates for the staff and student commute, and travel from home for students. We need more work in these areas, and completing the methodology will be a big step towards quantifying our Scope 3 emissions.

Proactis and centralised business mileage claims have taken us much further on towards putting firm figures on Scope 3 emissions from transport. Our best estimates for CO2 emissions from different activities are now:

Mode	Flights	Bus	Ferry	Train	Taxi	Uni Bus	Mileage	Total
CO2e tonnes	7,216	26	1	368	14	77	257	7,719

These are verified via the ISO 14064 process

Tools available to reduce this would be increasing video conferencing and continuing to promote alternatives to single-occupancy cars for commuting. Technology may help here too: the efficiency of the UK car fleet will increase as new cars – even electric cars – are introduced over the next ten years, which would reduce emissions. Homeworking could help, though a staff member homeworking in winter and using central heating all day just for themselves could quite easily produce emissions greater than a singl e occupancy car journey.

An alternative may be to provide hot desks for staff at Langford and Stoke Bishop, so that not all staff have to commute to the Precinct every day, but would still enjoy good IT facilities and support, including video conferencing with the main precinct, and the social benefits of a communal atmosphere for work. We will explore the distribution of where staff live, using data from staff travel surveys, to explore the viability of this.

Other factors may overtake us – for example, housing developments planned for South Bristol and the city fringes may increase the number of affordable homes close to the main Precinct, reducing staff commutes.

We expect that pro-active measures on our part and efficiencies in the transport network de scribed above will mean that we can expect a reduction of carbon emissions from these activities to be 5% by 2020.

Termly Student Travel

We also estimated the burden due to the travel by students to and from their homes, using data from the Student travel survey. The carbon burden from this is estimated to be 14,900 tonnes in 2006/7, 70% of which is due to flights originating in East Asia.

A risk in this work is that some studies suggest that the global warming effect of fossil fuel burning in the air is greater than that it is on the ground[7], though Government does not yet have a settled view on how great this effect is[8] but could double the effect of the emission of CO2.

It was found that:

- Students return home more often than we expected, taking 3 return flights on average a year, and students from Singapore and Australasia making up to 5 long haul journeys a year. We could reduce long-haul journeys by using various methods to make staying in Bristol more attractive over breaks, particularly where students have already paid for accommodation. Relatively simple projects matching students with families and support groups in the local community could go some way towards facilitating this.
- It is likely that more East Asian students may be educated more locally over the next 10 years,
- We envisage that airliners will become more carbon-efficient over the coming years.
- We also expect that rising oil prices will raise air travel prices, making discretionary flying less attractive.

We therefore feel confident in setting a target of a 5% reduction in the carbon burden of termly travel to 2020.

6.3 Waste

As part of ISO14001 we estimated emissions due to waste as being zero, as no waste goes to landfill, and reuse and recycling are much more carbon-efficient than using virgin materials. We will continue to improve our methods for measuring and managing waste generation.

6.4 Water

There are small Scope 3 emissions due to our use of water. We estimate these to be in the region of 336 tCO2 a year. Schemes intended to rationalise and improve domestic hot water systems may also reduce our water consumption, and our infrastructure refurbishment programmes are being shown to reduce leaks substantially.

6.5 Other

Our largest tranche of other emissions comes from our sheep and cattle herds, around 1% of our total. We will wait to see how the needs of our vet school evolve before making a judgment on this issue.

Next Steps

Key areas for reducing Scope 3 emissions are:

- **Construction** – using the pre-existing BREEAM process to reduce the use of carbon-intensive materials.
- **Food and Catering** – using currently in-force internal policy tools to favour local produce and to reduce waste

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[7] http://www.direct.gov.uk/en/Environmentandgreenerliving/Greenertravel/DG_064429

[8] http://www.publications.parliament.uk/pa/cm200607/cmhansrd/cm070502/text/70502w0005.htm

- **Business Flights** – by promoting alternatives such as video conferencing
- **Staff and student commute** – via the current Staff and Student Travel Plans
- **Termly Travel** – this is difficult to influence, but it is so large that we need to investigate how communications could help students make low carbon choices.
- We are reducing the impact of our procurement of **other products** through Sustainable Procurement policies and supplier engagement.

7.0 Governance of the Carbon Strrategy

The CMP will follow a simple Plan, Do, Check and Act cycle. That is,

- Plan – Measure carbon, design a plan based on priority areas from the data.
- Do – Implement the plans actions and measure their impact.
- Check – Review the impacts and report on these and suggest recommendations.
- Act – Review recommendations, decide on changes, review and update the plan.

7.1 – Planning the Strategy

This was initially undertaken in 2009 with the help of the Carbon Trust and involved a wide ranging group made up of stakeholders from across the University, including the student body. This plan will be reviewed each year.

7.2 Carbon Director

Carbon is the responsibility of the Director of Estates/Bursar (who is also part of the senior management team) and who holds the title of 'Carbon Director'.

7.3 Delivery of the CMP

Day to day implementation of the CMP is managed by the Sustainability team based in Estates via the Head of Sustainability. This will involve implementing projects and initiatives, engaging with stakeholders and monitoring the impacts of the projects. Sustainability runs two groups to help with this implementation,

- A 'Carbon Reduction Delivery Team' made up of key people within the Sustainability team around carbon
- 'The Carbon Strategy Group', which draws in wider stakeholder such as engineers from Capital Maintenance and Infrastructure and Residences Managers.

These two groups help implement key technological programmes.

7.4 Stakeholder Engagement

These include: All Staff and Students, the Health Trusts, Local authorities, Local community

Key stakeholders include;

- Technical Staff in charge of high energy users,
    - Research principle investigators
    - Laboratory technicians

- Estates Committee, University Planning and Resources Committee and Capital Infrastructure Planning Board
- ICT Managers
- ASU Managers
- School and faculty managers,
- Students' Union representatives

Sustainability will directly engage with the key stakeholders above as they are gatekeepers for carbon intensive activities, to get their help in delivering carbon projects within their area as set out in the CMP; these will form a virtual group called the 'Strategic Carbon Engagement Group'.

Each year staff and students will be asked for carbon reduction ideas (starting November 2013), which can be reviewed by sustainability for inclusion in the Carbon Management Plan.

7.5 Annual Monitoring and Reporting

The CS will be reported on within the Sustainability Annual Report every September at Estates Committee (who represent all University stakeholders including the student body) and there will also be a separate annual report on the CS to senior management via the Capital Infrastructure Planning Board.

The report will cover the cost and all benefits from the Programme including:

- financial savings,
- CO_2 savings against target
- less quantifiable benefits, such as influencing the student body / local community

7.6 Annual Review

The CMP will be reviewed each year in January by the Estates Committee and where necessary the revised CMP will go to the University's Executive Board (UPRAC) for review and ratification.

We are also required to report on our carbon emissions annually under the CRC and we also audit our carbon emissions voluntarily under ISO14064-1:2006 (CEMARS).

8 Carbon Strategy Implementation Plan to 2020/21

		Budget Code	Remaining Budget Agreed at 1/8/17	17/18	18/19	19/20	20/21	Cash Saving a year by 2020/21	CO2 Saving a year by 2020/1
	Measure								
4.3.1	Space Heating Policy	(none)						-	
4.3.2	Small Works	BJ260001	1,200	300	300	300	300	240	929
4.3.3	Control	Not yet agreed			600				
4.3.4	Highly Serviced Laboratories	BJ260008	650	200	200	250		163	629
4.3.5	Monitoring and Targeting	In BJ260001							
4.3.6	Lighting	BJ260004	2,073	500	500	500	500	286	670
4.3.7	Reburnering	BJ260006	184	184				26	193
4.3.8	Renewables - Elec Heated Halls	BJ260052	206		206			41	124
	Renewables - PV and ASHP	BJ260009	624		200	200	124	78	234
4.3.9	CHP	Not yet agreed					3,495	467	689
4.3.10	District Heat	BJ260009		100				60	221
4.3.11	Electricity Storage	Not yet agreed			1,000			200	-
			4,937	1,284	3,006	1,250	4,419	1,561	3,689
						Total	9,959		-9%
							6	year payback	

We will bring cases for additional support for travel and transport, and other work pertaining to the avoidance of Scope 3 emissions, as they are developed.

B. WATER MANAGEMENT STRATEGY

Executive Summary

The main aim of this water strategy is to establish procedures and recommended actions to enable The University of Bristol to use, conserve and discharge water as sustainably as possible.

Sustainability will manage this strategy. It will be administered with the Carbon Strategy Implementation plan and be subject to the same rules on payback.

Legislation

The Water Act 2003 requires public bodies, including academic institutions, to conserve water. The Water Regulations were created under the Water Industry Act 1991 to ensure the safety of the water supply. The five main purposes of the Water Regulations are to protect against:

- Contamination
- Waste
- Misuse
- Undue consumption
- Erroneous measurement

This strategy is concerned with the waste and undue consumption sections of the regulations.

The non-domestic water retail market de-regulated on 1st April 2017. De-regulation will enable The University to switch our water retail services to an alternative supplier and negotiate contracts for these competitively. However, our current best advice is that, for a user of our size for whom margins are already low, savings may be less than 1%.

Background

The cost of water and sewerage services to the University of Bristol is £900k a year. We have already made great inroads in water consumption, largely through updating infrastructure and resolving long-standing leaks, and despite a growth of a third in the number of FTEs and area served since 2007/8, consumption has reduced by 28% to 352,000m^2 a year.

Potential changes in charging and improved metering options have made water management increasingly financially viable, and the twin pressures of rising prices and water stress have made action more urgent.

Water consumption 07/08 to present

Year	m3	Variation	
07/08	491,473	0%	
08/09	448,713	-9%	
09/10	445,265	-9%	
10/11	448,161	-9%	
11/12	416,403	-15%	
12/13	367,037	-25%	
13/14	379,022	-23%	
14/15	384,067	-22%	
15/16	354,425	-28%	
16/17	352,111	-28%	Provisional

Roughly half of all water is used by residences, and half by academic and administration buildings.

Key Areas of Consumption

As previously stated, consumption of water is split almost equally between residences and academic and administration areas. However, amongst these, there are areas of heavier usage which we judge to present especially good opportunities for water saving.

Four buildings account for half of our non-residential consumption, and a quarter of our total consumption: Physics; Biomedical Sciences; Chemistry and the Richmond Building. In the scientific buildings, the high consumption is likely to be due to the large amount of direct to drain cooling, which could be cost-effectively improved with better control, or replaced with electric chilling. In the Richmond Building, water consumption is largely connected to consumption at the swimming pool.

In the residences, water consumption is driven by the requirements of the students, but there are some indications that catered halls use disproportionately more per head that non-catered halls.

Proposed Efficiency Programme

Sustainability will operate the following programme:

- Implement half-hour resolution, remotely-readable water metering to building level, to allow identification and action against unnecessary night-time use, and benchmarking between buildings
- Identify direct to drain cooled equipment and investigate alternatives
- Identify savings in our commercial kitchens
- Identify and fix leaks as soon as possible
- Replace any oversized water meters
- Arrange the repair of any dripping taps (up to 20ltrs per day)
- Manage urinal controls

- Identify processes and equipment that save water and if financially viable deploy.
- Awareness campaigns will continue to include water consumption and saving initiatives.
- Encourage the use of tap water as drinking water in place of commercial bottled water.

Target

Against a backdrop of strong growth in staff and student numbers, our target is to keep annual consumption below 352,000m2 from now until 2020/21, giving a relative reduction in water use per per FTE, and saving up to £100k against business as usual.

Funding of works

Sustainability will identify low/zero cost options to be actioned immediately. Low cost options with a payback of five years or less will be funded from the Sustainability Small Works Budget (UTIL BJ260001 6605). Projects that fall outside of the Sustainability Small Works Budget will be presented to the Capital Infrastructure Project Board for consideration, applying the same fiscal rules as the Carbon Management Plan.

Additionally, sustainability will encourage the implementation of water efficiency options at all scales of building refurbishment.