Scottish Universities Carbon Management Performance Review Project

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Executive Summary

To date, most universities have completed, or are in the process of completing, their Five Year Climate Change Action Plans. In light of this, the Environmental Association for Universities and Colleges (EAUC) have been tasked with reviewing the performance of Scottish universities in relation to the listed key points:

- Have Scottish universities adhered to their carbon management (CM) strategy?
- To what extent have reduction projects been implemented?
- What are the drivers affecting universities in achieving reductions?
- What are the key technical themes that universities are considering in order to reduce utility consumption and carbon emissions?

In summary, research of these four points above has found:

To date universities are achieving carbon reductions in the context of business growth within the sector. There has been a high rate of implementation of projects and this has helped to reduce the impact of sector growth. However more can be done.

The available evidence suggests that Scottish universities have tried to adhere to their carbon management plans, but are not on track to meet the legislative target for Scotland as a whole.. The evidence is limited as no formal consistent monitoring and reporting of CM processes was required or requested by key bodies until the template for the Universities and Colleges Climate Commitment for Scotland (UCCCfs) progress reports was introduced in 2013. In addition, most HE institutions have undergone significant changes over the past 5-years, including new and refurbished built estates, where the impact of CM activity may be masked by this notable change. It was also noted that even though in most institutions there are key members of staff directly responsible for CM, the issue was not generally embedded at all levels. This has a limiting effect on implementing reduction activities. The EAUC and Scottish Association of University Directors of Estates (SAUDE) Executive will continue to engage on this with the SFC.

A review of the available data shows that a modest decrease in carbon reduction has occurred and that this is part of a general reduction trend. The data shows that most of this reduction is due to traditional energy efficiency projects being implemented such as heating and hot water controls as well as physical estate renewal and rationalisation. The focus of these projects tended to be on reducing gas consumption. This would suggest that institutions need to refocus on electricity consumption and control.

Future project themes under consideration seem to follow in the same vein as completed projects i.e., energy efficiency and building optimisation. However, the number and scale of projects in process needs to be greatly increased if the sector is to achieve any substantial carbon reduction over time. A greater diversity of project types is also needed, now that many of the easier approaches have been explored and given that no single 'innovative' technology will address all of the challenges involved.

Support will be needed from the Scottish Funding Council, EAUC, SAUDE and other supporting organisations to encourage a more holistic and ambitious response from institutions to the Climate Change Act.

Introduction

The Environmental Association for Universities and Colleges (EAUC) has been tasked by the Scottish Funding Council over a 6-month period to review the performance of Scottish universities in relation to the listed key points:

- Have Scottish universities adhered to their carbon management (CM) strategy?
- To what extent have reduction projects been implemented and progress made?
- What factors are driving emissions for universities?
- What are the key technical themes that universities are considering in order to reduce utility consumption and carbon emissions?

The methodology, results and conclusions of this project are outlined within this report.

The focus of the project was on the implementation performance and data analysis of Scottish higher education institutions in relation to their carbon management plans (CMPs) and provides an assessment of future technologies required to meet carbon reduction targets.

Between the years of 2007/8 and 2010/11 all Scottish higher education institutions became signatories of the Universities and Colleges Climate Commitment (UCCCfS) and many took part in the Carbon Trust's Carbon Management programme. This assisted universities in creating an organisational strategy and practical project list that each institution would implement over a period of approximately five years in order to achieve carbon emissions reductions. These emissions reductions were noted as percentage reduction targets and were assessed against a baseline year identified in the CMP or UCCCfS Climate Change Action Plan (CCAP). These baseline years ranged from 2006/07 to 2009/10. The Plans were not simply focussed on direct energy and fuel consumption, but also on the impact of waste discard, water use and business travel; and where a CCAP was created, learning, teaching and research activity. Plans therefore tended to have a broad focus on all aspects of carbon emissions and estates development related to their institutional function. (For the purpose of this report, we will refer to all Plans here forward as CMPs.)

Additionally during this time period, the Scottish Government passed the Climate Change (Scotland) Act 2009[1]. This has committed the Government to achieving a demanding national CO_2e reduction target of 80% by 2050 (against a 1990 baseline) with an interim target of 42% by 2020. Key to the legislation is Section 44 - Public Bodies Duties Regulations. The Duties require that a public body must, in exercising its functions, act:

- In the way best calculated to contribute to delivery of the Act's emissions reduction targets;
- In the way best calculated to deliver any statutory adaptation programme; and
- In a way that it considers most sustainable.

Section 44 will have a key implication for all public bodies in Scotland in relation to climate change performance and mandatory reporting which will come into effect next year.

[1] Climate Change (Scotland) Act 2009 - www.gov.scot/Topics/Environment/climatechange/scotlands-action/climatechangeact

Methodology

Carbon emissions information has been gathered (where possible) for each university in Scotland. The data period ranges from 2006/07 – 2014/15. Most institutions were unable to provide a complete series of absolute data (within the time series) from their own records. As a result of this, HESA[2] data was used to calculate annual emissions totals. This data was broken down into seven main emissions sources (reflecting the CMP emissions sources):

- Electricity consumption
- Gas consumption
- Other fossil fuel consumption
- Heat and steam generation
- Waste discard to landfill
- Mains water consumption
- Business travel emissions

All CO_2e emissions arising from each source were calculated using appropriate official DEFRA[3] carbon conversion information relative to each emissions source. Carbon data calculated from each source in a given year was then added together to produce an annual total for that year. The analysis used absolute emissions figures provided by the universities where possible. HESA data was then used to provide emissions totals for missing sources and years. Some annual totals have been estimated (using a direct comparison approach) where no emissions information was available from the university or HESA. A more detailed breakdown of the data used can be found in *Annex A*. It should be noted that estimation techniques were only used to bridge small data gaps in annual totals - where large data ranges were unavailable for key sources or years; this information was left blank to avoid large inaccuracy. It should also be stated that the most complete data series ranges from 2006/07 to 20012/13. This is due to the fact that HESA was still to publish data relating to 2013/14 at time of this report. In light of this, all analysis contained within this report will focus on the period of 2006/07 – 2012/13.

It is important to state clearly that this report has been compiled largely with secondary data made available from HESA. HESA information, whilst useful, may not match up with the total emissions sources that each organisation identifies within their CMP. It is also important to mention that some emission source data was not available for certain years and that the reporting structure and metrics used by HESA can vary regularly, making the information challenging to navigate and interpret.

For the purpose of this report, upstream scope 3 emissions have not been included due to inconsistencies of data collection and monitoring across the sector. It is worth noting that scope 3 supply chain emissions are captured by the Advanced Procurement for Universities and Colleges (APUC) and have provided valuable data, however was deemed out of scope for this project.

The carbon management plans of all Scottish HE institutions (with the exception of Royal Conservatoire of Scotland) were reviewed with the following[4].

- General adherence to the CMP
- Impact of project implementation in relation to carbon emissions reduction
- Relevance and scale of implemented projects

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[2] Higher Education Statistics Agency - www.hesa.ac.uk/

[3] DEFRA carbon emissions conversion factors - www.ukconversionfactorscarbonsmart.co.uk/

[4] University of Highland and Islands and SRUC have been included where data and information was available in the review.

- Forward planning for future CMP

Given the lack of primary data and HESA data for some of the institutions for some reporting years, it has been necessary to exclude three institutions (UHI, SRUC and RCS) from certain parts (or all) of this analysis. *Table 1* below provides information on this.

HE institution	Comments
The University of Aberdeen	Data set included in report
University of Abertay Dundee	Data set included in report
The University of Dundee	Data set included in report
Edinburgh Napier University	Data set included in report
The University of Edinburgh	Data set included in report
Glasgow Caledonian University	Data set included in report
Glasgow School of Art	Data set included in report
The University of Glasgow	Data set included in report
Heriot-Watt University	Data set included in report
Queen Margaret University	Data set included in report
The Robert Gordon University	Data set included in report
The University of St Andrews	Data set included in report
SRUC	Data set included where possible
The University of Stirling	Data set included in report
The University of Strathclyde	Data set included in report
The University of the West of Scotland	Data set included in report
Royal Conservatoire of Scotland	Data set not included in report
University of the Highlands and Islands	Data set included where possible

Table 1 – University Data List

The information requested from universities comprised of the following.

- Carbon Management Plan
- Annual (and disaggregated) carbon emission and energy consumption data, where available for years 2006/07 – 2012/13
- HESA carbon and energy consumption data, where available for 2006/07 – 2012/13[5]
- Anecdotal evidence provided by each university during site visits
- List of implemented reduction projects relevant to the CM

In further assessing the progress institutions have made against their own targets, a set of five questions were asked to provide an outline for next steps moving towards 2020.

1) What progress has the sector made against targets and how does this inform overall sector ambitions?
2) What factors are driving emissions in the Higher Education sector? What is the Business As Usual?
3) What is the distribution of implemented project against the end use of emissions and what are the potential gaps in this distribution that can be exploited further?
4) What future opportunities have been identified and what gaps are there?
5) What conclusions can be drawn from the analysis and how can the key findings be used to inform future funding and support of the sector?

[5] Higher Education Statistics Agency - https://www.hesa.ac.uk/

Results

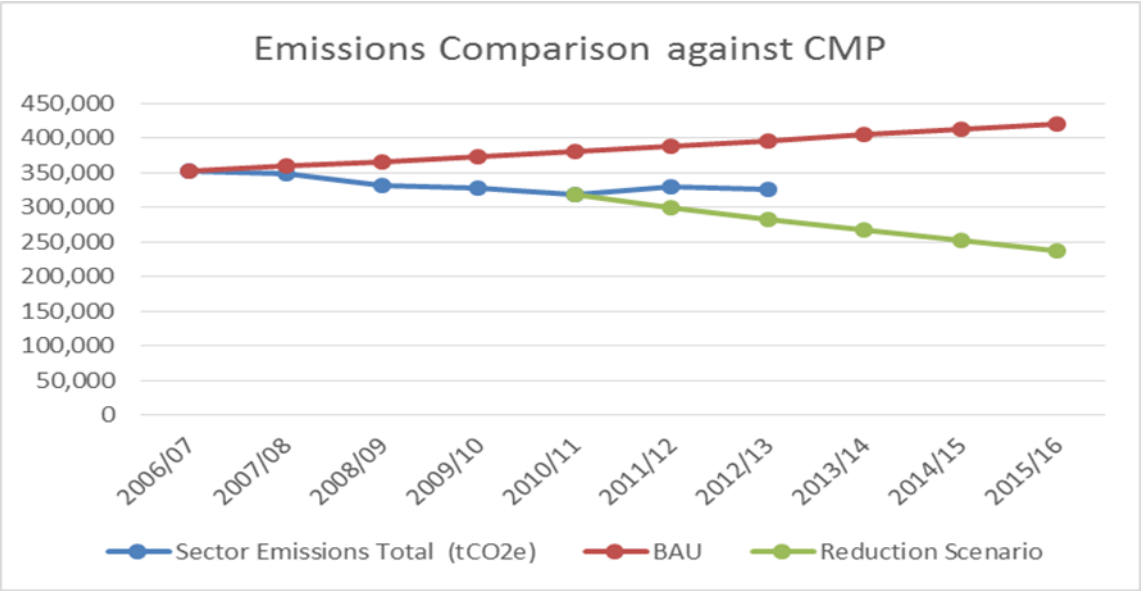
General Adherence to the CMP

Of the 17 universities visited, it was generally observed that most individuals who have a direct responsibility to carbon management, or whose roles are linked to carbon management issues, are informed and committed to achieving the aims set out in the CMP.

However, despite the dedication shown by these relevant staff, many individuals were of the opinion that awareness and commitment to carbon management was not fully embedded across the entire institution and, crucially, not across all senior management and academic staff. This has had the effect of establishing carbon management as a general maintenance and estates issue rather than a fully integrated aspect of institutional function, such as health and safety etc. This has had a limiting effect on the impact that carbon management could make in universities.

It is also the case that most universities have, or will, fail to achieve their stated carbon reduction targets within existing Plans. What the results of this study suggest is that institutions in general are addressing financially and technically robust energy efficiency projects, but that the scale and number of these projects needs to be increased.

Most carbon management plans began in 2010/11, finishing in 2014/15 or 2015/16, using a baseline comparison year of 2007/08. The average target stated in the CMPs is 23%. Assuming an incremental decrease in overall carbon emission starting from 2010/11 towards that stated target (green line), *Graph 1* below shows that the sector is off-course in relation to emissions reduction (blue line), whilst still achieving some reduction.



Graph 1 – Sector Carbon Performance

Overall, the sector is reducing in terms of total carbon emissions; however, it is not following an average reduction scenario representative of all carbon management plans developed over the past 5 to 10 years. The results of this study also suggest that there may need to be a refocus on electricity reduction projects. For most universities, total emissions associated with electricity use will be significantly higher than those from burning natural gas. However, as electricity generation decarbonises the relative contribution of electricity use towards total emissions will decrease: emission factors for electricity should decrease in future years while those for fossil fuels will remain relatively static.

Carbon Management Performance

In order to achieve the above target baselines, the sector as a whole would have had to identify and implement projects totalling an annual carbon emissions tonnage of 90,246 tCO_2e. While some institutions have met and exceeded their targets, others are unclear at this stage of their CMPs if this is achievable and a few that will not meet their targets. However, the figures indicate that collectively, the sector has not met the targets set in the Climate Change Act. There has been a great deal of effort and progress made, however the changing landscape of growing estates has had an impact.

Project Implementation Rates

Of all institutions that provided project implementation information, 4 completed their project registers in total. The general trend of implementation was high with an average rate of 76%. This suggests a commitment to address carbon reduction activity. However, a significant number of projects listed for all universities seemed to be derived from established action plans created from SALIX funded activity. Whilst this action is to be commended, the SALIX funding principles and payback timescales can limit the scale of projects to a small and medium size, due to the 8-year payback maximum timeframe. This may have had a limiting effect on the likelihood of larger reduction target achievement. However, Salix eligibility criteria means that it was the only funding often available to projects that would not otherwise have proceeded. Therefore the value of Salix funding should remain as an enabler.

The total annual carbon tonnage attributed to all projects listed within CMPs is 51,459 tCO_2e. This total equates to 57% of the notional target that needed to be achieved in relation to all institutions achieving their carbon reduction targets. All projects implemented to date total an annual tonnage of 41,436 tCO_2e as outlined in *Table 2* below. This again takes the sector further away from the total reduction target, meaning that all institutions need to identify and implement a significantly greater number of reduction projects in general. It should also be noted that many universities have undertaken or managed ongoing awareness campaigns. The savings impact of these projects is very difficult to quantify but remain invisible within most CM Plans.

HE Institution	Total Number of projects	Implementation Rate	Total tCO_2e reduced (annual)
The University of Aberdeen	70	71%	7028
University of Abertay Dundee	36	83%	1201
The University of Dundee	14	93%	2637
Edinburgh Napier University	56	73%	906
The University of Edinburgh	34	100%	1962
Glasgow Caledonian University	53	66%	1213
Glasgow School of Art	10	80%	508
The University of Glasgow	32	100%	1475
Heriot-Watt University	22	77%	1274
Queen Margaret University	34	74%	2498
The Robert Gordon University	11	55%	5515
The University of St Andrews	116	100%	3125
SRUC	27	41%	101
The University of Stirling	88	37.5%	7358
The University of Strathclyde	26	100%	2476
The University of the West of Scotland	39	79.5%	2048
University of the Highlands and Islands	8	75%	56

Table 2 – University Carbon Emissions

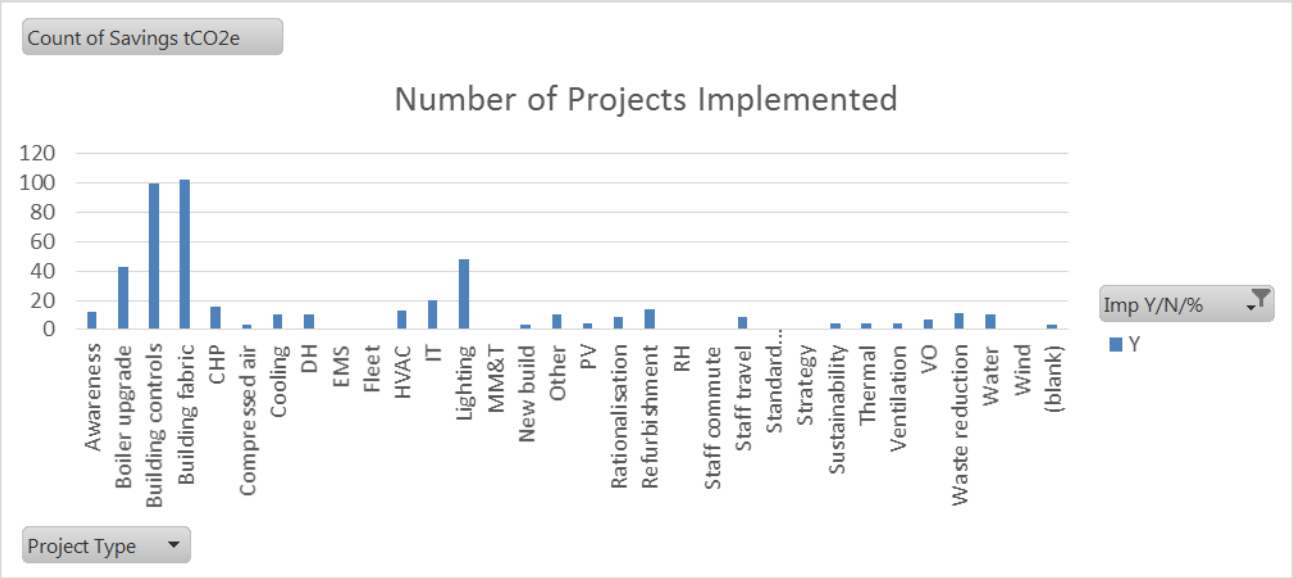
Carbon Management by Project Type

A total of 675 projects were listed throughout all the carbon management plans reviewed. Of these, 514 were fully implemented at the time of this review. *Table 3* below shows the cumulative annual saving (as listed in the CMP project register) of each project type. It should be noted that the savings listed may not reflect the actual savings realised. However, these totals can still be used to approximate the impact of carbon management as a whole.

Project Type	Total Savings (tCO2e)
Awareness	2,620
Boiler upgrade	5,475
Building controls	7,857
Building fabric	2,974
Combined Heat and Power	4,925
Compressed air	32
Cooling	1,030
District Heating	794
Energy Management Systems	72
Fleet	23
Heating, ventilation, and air conditioning (HVAC)	369
Information Technology	1,438
Lighting	1,623
Monitoring, Measuring, & Targeting (MM&T)	751
New build	4,898
Other	325
Photovoltaics Panels	27
Rationalisation	1,730
Refurbishment	1,091
Renewable Heat (RH)	9
Staff commute	3
Staff travel	347
Strategy	389
Thermal	223
Ventilation	97
Voltage Optimisation (VO)	2,039
Waste reduction	146
Water	103
Wind	26
TOTAL REDUCTION	41,436

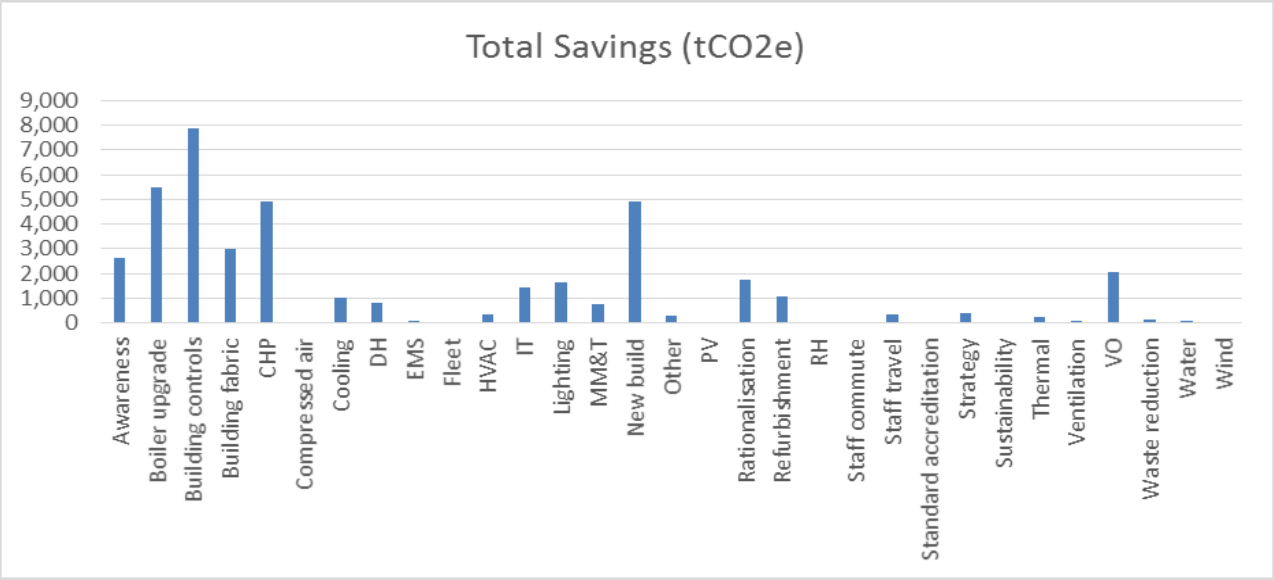
Table 3 – Project Type and Total Emissions

Number and Types of Projects Implemented



Graph 2 – Number of Implemented Projects

Total Projects Implemented



Graph 3 – Grouped Savings of Project Types

As can be seen from *Graphs 2 & 3* above, the majority of implemented project savings are related to upgrades and improvements in building control, plant and fabric. The top five project groups are as follows.

1. Building control projects generally refer to upgrades in specific and building control systems such as lighting, heating, ventilation and presence detection as well building energy management system improvements.

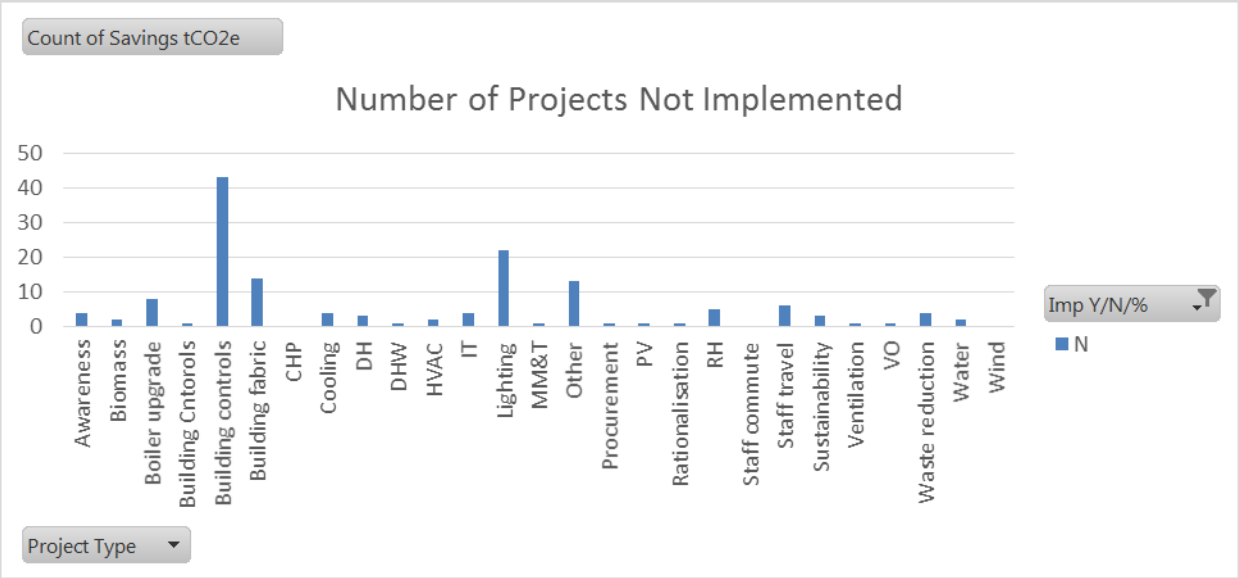
2. Many institutions are also involved in upgrade of old inefficient gas boiler plants. In most cases these projects seem to be part of general maintenance and rolling programmes as boilers reach their end of life.

3. New build projects are prevalent within the sector as many institutions have been in the process of renewing and increasing their estate over the past 5 years. These new structures should be of a better standard in terms of building fabric and air tightness as well as improved utilities and service monitoring and control.

4. Implementation and upgrade of CHP units account for a significant carbon reduction total. Combined heat and power plants are ideal for sites with extended demand for power and hot water over a 24 hour period.

5. Building fabric projects are grouped as internal and external insulation, draught stripping, and window and roof replacement.

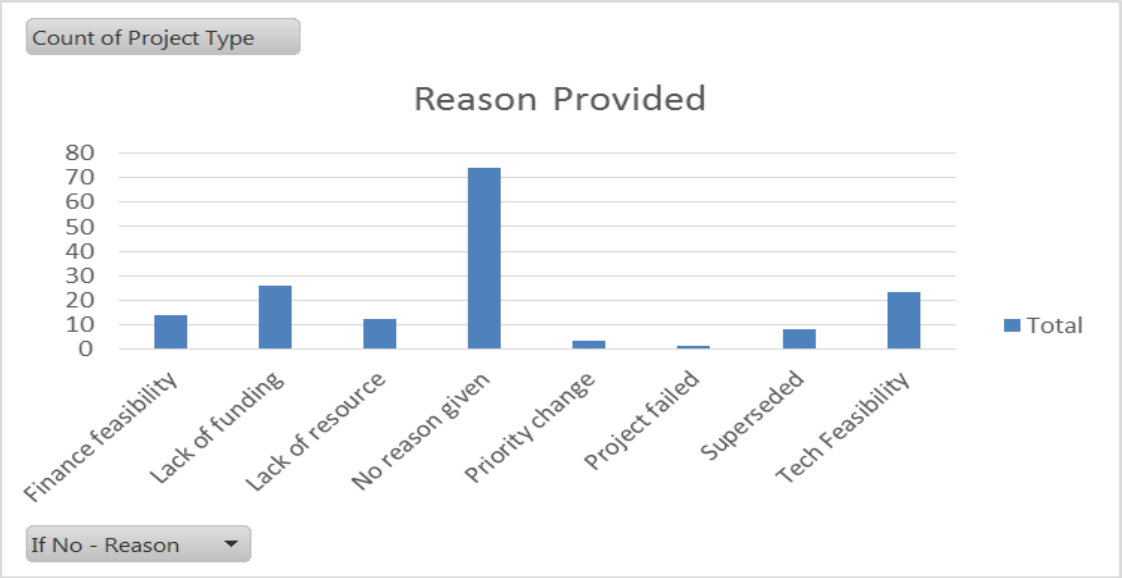
Non-Implemented Projects



Graph 4 – Project Types Not Implemented

Of the remaining 161 non implemented actions, outlined in *Graph 4*; building controls, lighting and building fabric projects are the main types rejected from project registers. It shows a rough proportionality in relation to implemented projects, with building controls showing the highest rejection total.

Reasons for not implementing projects



Graph 5 – Reasons for Non Implementing Projects

Graph 5 above shows the majority of non-implemented projects, no reason was provided for why these projects did not go ahead. This was in part due to staff changes and an absence of recorded information in relation to CM projects. Until information for these unexplained project rejections are found, it is difficult to ascertain if there is a trend in relation to why they were not enacted. SAUDE will investigate into other possible reasons to assist with future projects

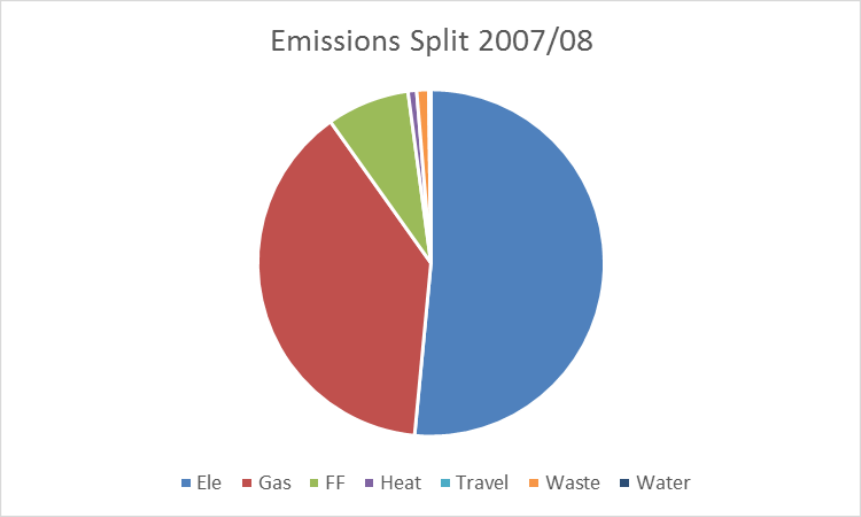
Carbon Emission Split

In order to assess the impact of projects within an organisation, it is useful to assess the split in carbon emissions in relation to their sources, shown below in *Table 4*. Over time the proportion of emissions from each source may change in relation to the impact that carbon management has had.

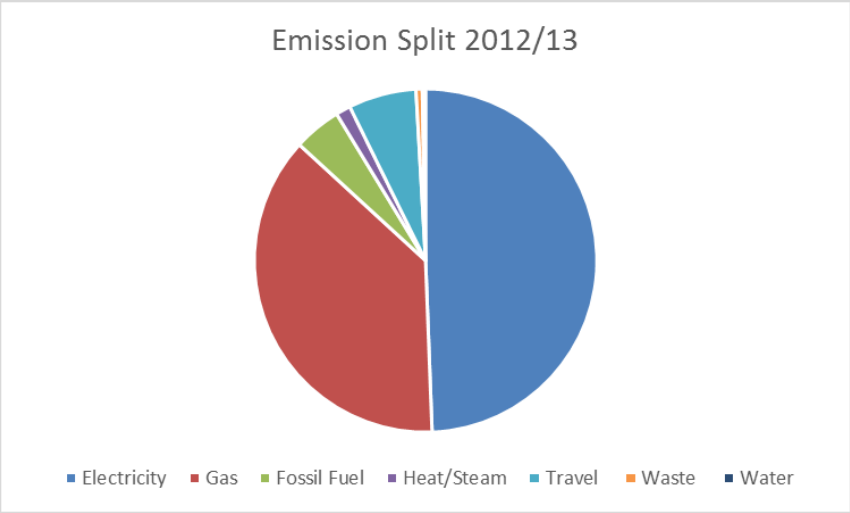
Source	2007/08 Split	2012/13 Split	Change +/-
Electricity	51.5	49.4	-2.1
Gas	38.6	37.4	-1.2
Fossil Fuel	7.7	4.5	-3.2
Heat	0.8	1.4	+0.6
Travel	0	6.4	+6.4
Waste	1.1	0.6	-0.5
Water	0.2	0.3	+0.1

Table 4 – Carbon Emission Split

Emissions splits can show whether a dent in carbon emissions has been made in a particular source, showing a propensity for certain project types. In short, it can help to show whether you need to focus projects on a particular area. However, this data doesn't show that. What it does show is a decrease in fossil fuels and an increase in travel data. This is likely due to increased travel data being recorded and better data collection.



Graph 6 – Emission Split 2007/08



Graph 7 – Emission Split 2012/13

The above *Graphs 6 & 7* show that there has been little movement in the percentage split over time. Fossil fuel emissions have reduced showing that institutions have likely switched fuel or closed buildings that relied on these traditional fuel types. Emissions from heat/steam have also increased slightly and this possibly reflects the increasing influence of CHP and district heating. Overall however, the proportions of emissions arising from gas and electricity have remained steady with a slight decrease, possibly in relation to a more rounded emissions boundary that takes in smaller sources such as travel and water. This reflects an increase in sophistication of recording and monitoring carbon. If more time was available, it would have been useful to include further analysis on trends in total electricity and gas use across the sector, rather than expressing in carbon. This would demonstrate progress in energy efficiency and demand reduction without the complicating factor of varying emission factors, which institutions cannot influence.

Decarbonisation of the electricity grid offers the potential of low to zero carbon heat via heat pumps in the medium to longer term, and emphasis on renewable heat in general perhaps needs to be increased. It may be worth further developing themes touched on in the report about short, medium and long term strategies and the actions institutions should be taking to ensure that the transition to the long term vision is as efficient as possible.

Combined Heat and Power

Of the existing current and completed project lists, 15 CHP projects were cited on project registers and 14 had been implemented at the time of this survey. This accounts for a total annual carbon reduction impact of 4,925 tCO2e across the sector. It is backed up by an observed rise in the total emissions related to heat/steam, as previously stated. Over 50% of the total number of universities across the sector sited CHP as a probable future technology that would be implemented in the coming years. While this is a viable option, it is recommended that building controls are audited first to ensure existing systems are running efficiently.

CHP still has the potential to make a significant impact on overall Scope 1 and 2 emissions, and to provide significant cost savings. The relative carbon reduction benefit of gas fired CHP will however erode as electricity generation decarbonises (perhaps in only around 15 years or so) where there will be lower carbon emissions in using grid electricity.

Assessment of Targets Progression

Progress against targets

The first analysis question in assessing progress looked at where the universities were in terms of their targets. This cohort analysis is not straightforward because the sector does not start from the same point in terms of baseline year, have the same target, or the same end year for the target, nor does it have the same most recent year of carbon footprint publication. In order to compare the universities equitably, a calculation of current versus expected position was made using the total number of years in the target phase.

The results are shown below in *Table 5* and demonstrate the range of positions with respect to targets. Of the sample included in this analysis (16 universities), 11 institutions are ahead of where they would be expected to be (score of more than 100%). None of these institutions have published data that enables confirmation that the target has been met but they are on track to deliver against their targets. Three institutions made reductions in their footprints but are behind where they would be expected to be (score of between 0 and 100%) and a further two have increased their carbon footprint (score of less than 0%). Although there are more universities that are ahead of their expected position to date, across the sector, there are more emissions in the amber and red categories (43% ahead and 57% behind). This is due to the larger size of the footprints in the bottom section of the table.

There are likely to be a number of explanations for the patterns in this table which will be explored in subsequent sections. However, it should be noted that for a significant proportion of the sector, the most recent data for their carbon footprints came from HESA returns (highlighted in red), rather than published by the organisation. Therefore, there could be discrepancies in the carbon footprint boundary measured in the baseline year versus the most recent footprint.

Organisation	Baseline year	Baseline footprint (tCO_2e)	Start Year	End Year	Number of years in target period	Most recent footprint	Year of most recent footprint	Number of years left	Expected reduction to date	Reduction to date	Progress against expected position
Glasgow Art School	2008/09	3,528	2009/10	2014/15	5	1,958	2012/13	2	318	1,570	494%
GCU	2008/09	10,952	2010/11	2015/16	5	8,298	2012/13	3	876	2,654	303%
Abertay	2008/09	4,222	2011/12	2016/17	5	3,582	2012/13	4	211	640	303%
Strathclyde	2009/10	32,690	2010/11	2014/15	4	28,026	2012/13	2	1,635	4,664	285%
Glasgow	2007/08	64,275	2009/10	2014/15	5	43,487	2012/13	2	7,713	20,788	270%
RGU	2008/09	15,179	2010/11	2020/21	10	9,850	2014/15	6	2,550	5,329	209%
QMU	2009/10	2,297	2010/11	2015/16	5	1,482	2012/13	3	472	815	173%
Edinburgh	2007/08	78,702	2010/11	2020/21	10	90,785	2013/14	8	7,666	12,083	157%
UWS	2008/09	11,499	2010/11	2014/15	4	9,748	2012/13	2	1,150	1,751	152%
Edinburgh Napier	2006/07	11,166	2008/9	2013/14	5	8,063	2012/13	1	2,233	3,103	139%
UHI	2009/10	454	2010/11	2015/16	5	389	2013/14	2	27	37	136%
Aberdeen	2008/09	29,336	2009/10	2014/15	5	25,055	2012/13	2	3,520	4,281	122%
Stirling	2007/08	16,651	2008/09	2012/13	4	14,742	2012/13	0	3,330	1,909	57%
Heriot Watt	2007/08	19,445	2009/10	2013/14	4	17,878	2013/14	0	4,375	1,567	36%
Dundee	2008/09	25,367	2010/11	2015/16	5	25,023	2012/13	3	2,029	344	17%
St Andrews[6]	2006/07	36,861	2010/11	2016/17	6	41,799	2014/15	2	4,915	-4,938	-100%

Table 5[7]: Position of universities with respect to targets taken from reviewed carbon management plans

[6] Reflective of the zero carbon projects

[7] Figures in red indicate where data has been estimated due to lack of available or anomalous information was used in place of primary data available from institutions

What this means in terms of longer term Scottish targets relates to the Climate Change (Scotland) Act and set long-term targets of 42% by 2020 and 80% by 2050, but both of these are based on a 1990 baseline, which few institutions have the data to assess. The SFC allows individual universities and colleges to set their own targets through the CMPs using 8% per annum as an aspiration. These statistics show that the public sector 8% per annum would be an extremely challenging target for the sector as a whole, based on the current evidence. If it is reasonable to assume that many of the easier and most cost-effective reduction projects have already been implemented, reductions are likely to get progressively harder over time.

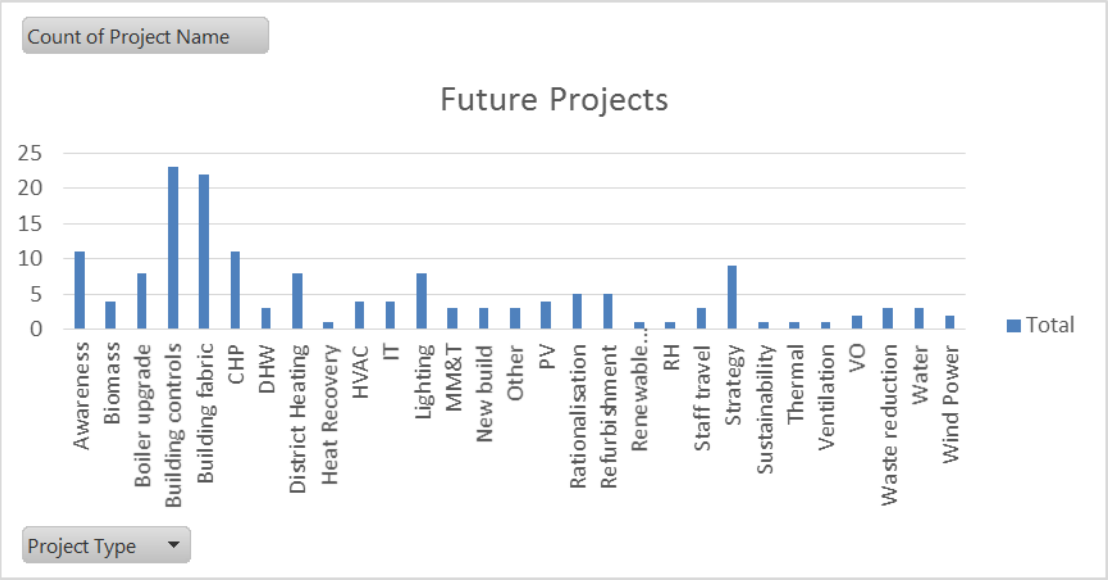
Recommendations:

In order to be able to understand what sort of sectoral targets are realistic, it is important to understand:

- The baseline and boundary that institutions are working to; over time these should be encouraged through guidance and tools to be similar e.g. by 2020/21, it would be useful for universities to set a similar carbon footprint boundary for the same baseline year.
- What is the underlying growth in the sector (what Business As Usual is for the Higher Education sector in terms of emissions)?
- What opportunities are left to decrease the sector footprint through carbon reduction projects? This is not a static position but will evolve over time with technology and understanding of how to make projects work
- What is the funding and resourcing appetite within the sector and from the SFC?

Future Projects

A total of 154 projects have been identified by the sector.



Graph 8 – Future Projects

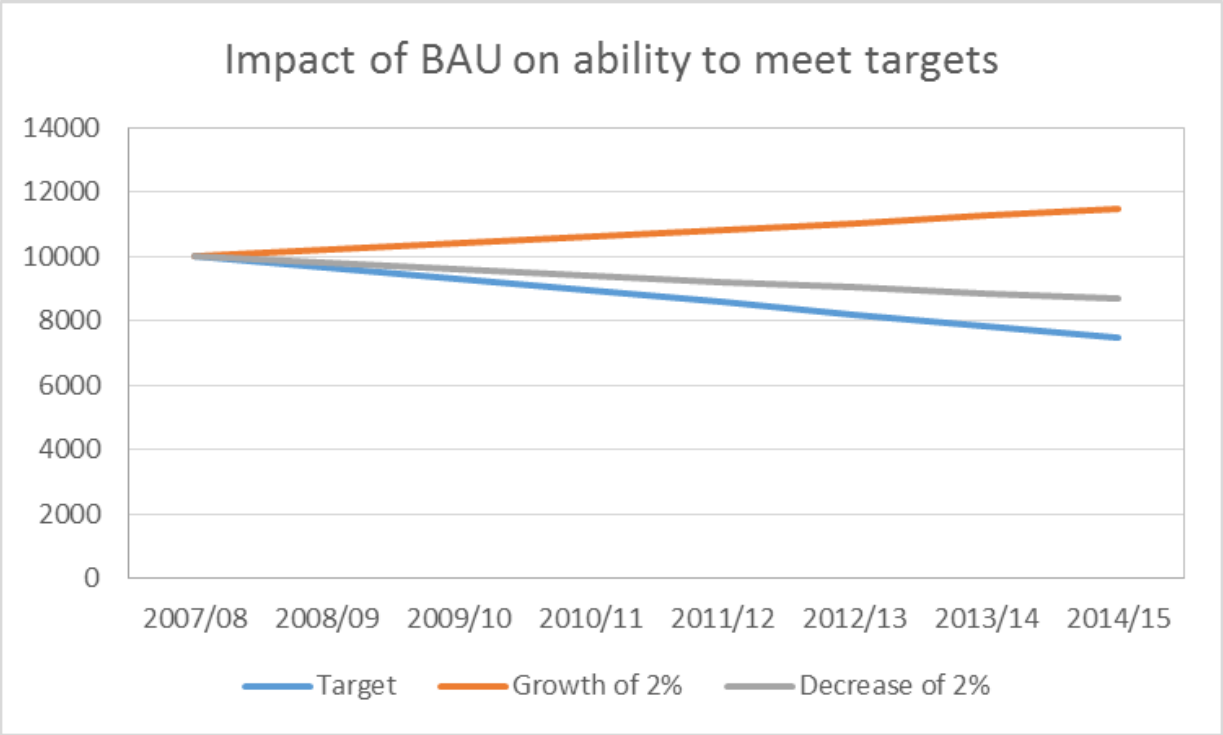
All universities were asked to provide information relating to future projects that they intended to undertake to further reduce utility consumption and carbon emissions. Only one institution was able to provide a partially costed project list. The remaining universities provided information on general approaches and technology themes that would form part of their future CMPs. *Graph 8* above shows that the trend of project types mentioned is broadly proportional to the identified and implemented projects of the former CMPs.

Business as Usual and the University Sector

There has been increasing attention over the past five years paid to the underlying growth or decrease in the carbon emissions of a university as a result of both internal and external factors that are out with the control of those dealing with climate change activity. This is collectively referred to as the Business As Usual scenario, although this is a slightly misleading term. At the time when most of the Scottish Higher Education Institutions were writing their first CM Plans, BAU was generally modelled as a 0.7% increase in emissions over the whole of the footprint, regardless of the source of the emissions and without considering the actual circumstances of the individual university. However, understanding of the significance that BAU has on whether institutions are likely to meet their targets has improved considerably since then following work with other public sector organisations, such as Scottish Water and the Scottish Government.

It is useful to consider the implications of different patterns of BAU growth on the ability of a university to meet their carbon reduction targets.

Graph 9 below shows an institution with a baseline footprint of 10,000 tCO_2 in 2007/08 and a target of 25% to be met by 2014/15 (blue line). If the underlying growth in emissions is a 2% increase per year (orange line), then the institution will need to find nearly 4,000 tCO_2e savings by 2014/15 to meet the target, whereas if the organisation is decreasing by 2% per year (grey line), they will only need to find just over 1,000 tCO_2e by 2014/15 to meet their target. Therefore, the underlying growth or reduction in the BAU has a huge impact on the effort that an institution needs to put in to meet their target.



Graph 9: How different rates growth in BAU impacts on the ability of institutions to meet targets

What are the impacts of a university not undertaking an accurate forecasting of their BAU?

1) There can be a loss of faith by management in the process; if the BAU is increasing more rapidly than the carbon management team can implement projects to reduce it, it looks like the projects are not working and the investment is failing to produce results, whereas in reality,

the team is running very fast just to stand still. Effective forecasting and communication of the BAU can help demonstrate this.

2) If the BAU is decreasing and the institution is getting the benefit of both carbon reduction projects and reducing emissions from other factors, the institution can get complacent about the future effort that will be required to meet further and more stretching targets.

The impact of BAU on the ability of any institution to meet targets is starting to be recognised. In the Scottish Higher Education sector with the University of Edinburgh and the Scottish Funding Council investing in developing a specific tool to help them both forecast the impact of management decisions and also demonstrate the impact of management decisions on meeting targets. The University of Glasgow have been active in forecasting their BAU and in particular, the impact of the external electricity grid factor on their emissions.

- The factors' affecting the footprint of institutions is a tricky question (if it were simple, it would have been done a long time ago). In reality, the evidence is that there are multiple growth factors that impact on different parts of carbon footprints, in different directions and with different degrees of directness. A few of the potential factors are discussed in more depth below.

- **Decarbonisation of the electricity grid** – all organisations use an average UK electricity grid factor for calculating the emissions resulting from the Scope 2 generation of grid electricity and Scope 3 transmission and distribution losses. This factor is currently around 0.5 kgCO2e/kWh and is relatively volatile year on year as the generation mix changes to reflect different fuel prices used for generation. There are also a number of energy policies that are designed to decarbonise the grid (e.g. increasing the proportion of renewables in the grid); these policies make up a central part of the Government's strategy for achieving climate change targets. So far these policies have had little impact in decarbonising the grid as demonstrated by the table below.

	Generation	Transmission and Distribution Losses (T&D)	Consumption	% T&D
2002	0.44914	0.04111	0.49025	9.2%
2015	0.46219	0.03816	0.50035	7.6%
Percentage change	2.9%	-7.2%	2.0%	

However, the future might be different; currently each unit of electricity 'costs' more than twice as much carbon as a unit of gas. However, if the grid decarbonises, this relationship will change, making projects that save gas relatively more important in saving carbon. This will have a large impact on gas-fired CHP. The relative carbon reduction benefit of gas fired CHP will however erode as electricity generation decarbonises, to a point sometime in the future where carbon might be lower using grid electricity. Investment strategy to maximise carbon savings should therefore change over time if and when the grid decarbonises. One way to do this is BAU forecasting, including various different grid scenarios. However, predicting the rate of change of the grid carbon factor is very tricky and a good base assumption for the next 5 to 10 years is that it will be easier to decarbonise the grid if everyone is more

efficient and conservative about electricity use, especially at peak hours (the most carbon intensive forms of electricity are generated when demand is highest or rising). Therefore, electricity saving projects should be currently given a high priority.

- **Student numbers** – it is unlikely that student numbers have a simple and linear impact on carbon emissions. It is likely student numbers have more impact on emissions resulting from end uses of transport, waste, IT, catering and hot water, than on heating, HVAC and lighting as these are part of the energy running costs of buildings. However, the better the buildings are run in terms of matching energy use to demand and reducing energy use in unused areas, the closer student numbers should track overall energy consumption.
- **Income –** it should be noted that Higher Education institutions have multiple functions; education, research and, in some cases, consultancy. Income can increase independently from student numbers as research funding is attracted and this can also have an impact on carbon emissions, particularly if the money is attracted for energy-intensive activities. It can also have a large impact on international travel, if this included in the carbon footprint.
- **Floor area –** statistics around floor area for different use categories (e.g. residential, administrative etc.) is collected by HESA and would be worth analysing. There is likely to be relationships between emissions and floor area but these are likely to be complex, as other factors around using space more effectively. Such as taking older buildings offline, increasing the efficiency of new builds, increasing intensity of activities will all have an impact.
- **Research Intensity** – in addition to adding floor area and/or increasing student numbers, Higher Education Institutions can increase research intensity. As a result of attracting additional research grants, staff numbers and postgraduate posts could increase; existing equipment could be used more intensively and buildings could stay open longer hours and new equipment could be purchased that is more energy intensive e.g. supercomputers. There might be relationships in terms of income increases, but this would require disaggregation of income from different sources. It is anticipated that the effect of research intensity on carbon emissions would be greater in subjects such as science, engineering and medicine, than for arts subjects.

The table below shows some of the data from HESA around student numbers and income for the HE institutions in the sample. This shows that over this period, overall student numbers decreased slightly, although there were large differences between different institutions. During the same period, income increased by 15% overall, with all but one institution experiencing some level of increase. It should be noted that in reality, a small increase over this period once inflation has been added in is likely to be an actual reduction in income. The percentage change for these two parameters is shown in *Table 6*.

Organisation	Student numbers			Income (£k)		
	2013/14	2009/10	% change	2013/14	2009/10	% change
SRUC	1,565	1,005	56%	84,068	50,387	67%
Abertay	4,755	4,200	13%	36,747	36,252	1%
Edinburgh	27,625	25,690	8%	780,630	633,979	23%
Glasgow	27,390	25,600	7%	511,341	439,471	16%
St Andrews	9,735	9,135	7%	193,880	155,788	24%
Glasgow Art School	1,825	1,785	2%	29,642	21,403	38%
Stirling	11,090	10,870	2%	107,570	101,948	6%
UHI	7,465	7,505	-1%	62,731	68,174	-8%
RGU	13,410	13,715	-2%	103,329	94,321	10%
QMU	5,215	5,400	-3%	34,968	33,552	4%
Heriot Watt	10,895	11,295	-4%	191,302	142,662	34%
GCU	16,755	17,670	-5%	116,752	115,258	1%
Dundee	15,195	16,195	-6%	243,087	219,090	11%
Strathclyde	19,960	21,310	-6%	254,377	230,664	10%
Edinburgh Napier	12,690	14,100	-10%	112,750	105,708	7%
Aberdeen	13,825	15,535	-11%	232,499	225,289	3%
UWS	15,280	17,425	-12%	101,526	95,479	6%
Overall	214,675	218,435	-2%	3,197,199	2,769,425	15%

Table 6: Potential BAU growth factors from HESA data

Conclusions

Overall, it is difficult to draw firm and detailed conclusions in relation to the information provided by institutions through the course of this project. However, the data and anecdotal evidence provided shows a modest reduction in emissions over the course of the CM phase. The following conclusions can be drawn from reviewing the information.

Carbon Performance of the Sector

The initial review of carbon emissions is a positive one. The data shows a modest reduction and downward trend in emissions over the reporting time period. However, the reporting metrics used to assess carbon intensity in relation to institutional change shows the sector is working very hard to maintain lower emissions as it experiences significant estate growth and change.

This would suggest that that all reduction projects implemented so far have done a good job of maintaining the status quo and have prevented runaway carbon increase. However, a more strategic and large scale approach to carbon reduction needs to be addressed by the sector as whole if it is to make substantial carbon savings towards 2020.

Data Reliability and Monitoring

The majority of data used to compile this report was not primary information provided directly by institutions. This means that there are some key caveats to bear in mind when reviewing this information.

- Some of HE institutions in Scotland still do not specifically monitor and report on the progress of their carbon management plans. This means that data for some emissions sources initially identified within plans are not assessed.
- HESA data is sometimes not reflective of emissions totals provided as primary evidence by some institutions and in some cases, this information is estimated rather than actual. This may mean accumulated inaccuracies when aggregating emissions totals for the sector.
- Some carbon emissions source information can generally be difficult to obtain within institutions due to administrative, departmental and data collection issues. Staff travel data was noted as a key example.
- It has also been noted by institutions that some mandatory recording systems that automatically calculate emissions data do not produce accurate results. This was noted for the online procurement reporting system in use.

Recommendations for Institutions:

- Establish a robust and straight forward energy and utility monitoring system in order to fully understand all carbon emission sources within the boundary of an organisation.
- Put in place methodologies for better recording of travel, waste and water data.
- Make sure that all data recorded in relation to carbon management undergoes some form of limited assurance.
- Use data to inform and continually improve on performance using the “Plan – Do – Check – Act” cycle.

Overall Carbon Management Performance

The performance of the majority of institutions (and the sector as a whole) is good. Most institutions have attempted to adhere to their plans to the best of their ability in the face of marked sector and individual estate change. Most institutions were able to provide some evidence in relation to carbon

management work and most institutions had at least one named responsible person dealing with carbon management.

However, many within the sector cited lack of senior management support as a key barrier to fully integrating carbon management throughout their institutions. Lack of internal communication was also highlighted in that many departments and teams were not sharing enough information in order to work towards carbon reduction in a strategic manner. This lack of communication also caused maintenance and estates teams to have to play catch up in relation to decisions taken within faculties regarding equipment purchase, tender applications and academic research.

Recommendations for Institutions:

- Strengthen the management and governance aspects of CM within each organisation during the next phase of CM.
- Establish a comprehensive CM committee that will be tasked with deciding on strategic direction and dissemination CM information throughout the institution.
- Ensure that responsibility for CM is spread throughout the entire organisational management team. This can be done through establishing team or dept. performance targets or carbon/financial budgets in relation to utility consumption and by requiring "authentic leadership" from all responsible staff in relation to CM.
- Establish meaningful awareness and training programmes to ensure that all staff understand the importance of and are equipped to deal with CM.
- Include CM responsibility in staff contracts and appraisal processes.
- Improved reporting of carbon reduction performance and regular intervals should be established. These reports should reach the Principal and corporate management team for review and consideration.
- Establish a network of champions to make sure the CM message is spread and upheld throughout the institution.
- All university proposals and activities under consideration should also undergo a carbon appraisal.

Present and Future Project Implementation

The project implementation rate across the sector was generally high. This seems to be due to the fact that most projects were identified and quantified through the established funding model of SALIX. Although this is a valid way of identifying and, more importantly, ensuring that projects listed are implemented, there are still further opportunities available with an increased range and scale of projects linked to CM with wider capital investment options. In short, the success rate was high but the number of projects identified was limited to make a significant impact.

The project types most successfully implemented and delivering the largest savings tended to focus on building controls, CHP and boiler upgrade. This suggests that issues related to control and delivery of space heating and domestic hot water have been the mainstay of all CMP project lists. This needs to be rebalanced with more focus on electricity consumption. Most importantly (given the nature of higher education institutions) efficiencies in IT need to be addressed. Lighting is also a major issue given many university campuses own and operate significant amounts of external and street lighting. However often this isn't specified as to internal and external.

Recommendations for Institutions:

- Ensure a wide variety of projects are identified and implemented within the project register.
- Make sure that projects are of a scale and quantity that will help the institution achieve its carbon reduction goals.
- Project register should contain a list of both near and long term projects.

- Relevant internal data should be used to justify and quantify project action – this requires compiling and reviewing data from a robust metering and monitoring strategy.
- All projects should be SMART assessed before being listed in project register listing both achievable and aspirational as supported by Resource Efficient Scotland tools available.
- The project register should be filled as projects come to fruition and are completed. This is important for short term projects especially.
- Additional funding should routinely be made available for short term carbon reduction activity.

Reporting

The Public Bodies Duties regulations contained with the Climate Change (Scotland) Act 2009[8], now requires all publically funded institutions to return sustainability/climate change reports to the Scottish Government by 2016. This will be an annual requirement. The purpose of this reporting is to encourage organisations to address the key aspects of robust climate change management and to retrieve numerical data on progress in a uniform way that will over time produce a reliable and validated data set. Universities and colleges are listed as 'major players' under the Duties on Public Bodies.

Given the issues raised in this report regarding data, cultural change and CM leadership, the requirements of this new reporting structure will help to address some of these issues and improve the carbon management performance of all public bodies.

Recommendations for Institutions:

- All HE institutions should review the new reporting template and guidance that is currently available on the Sustainable Scotland Network website.[9] All institutions should review governance and management strategies that relate to CM and energy management within each organisation.
- All institutions need to be prepared to report total carbon emissions by scope or source for previous reporting years.

Future Technologies

The analysis to date shows that answering the initial questions was not necessarily simple due to the quality of the dataset and the inherent difficulties in analysing data that is not easily categorised. However, there are a number of key findings that should be used to inform future funding and support of the sector.

- To negotiate effective sector carbon reduction targets, there needs to be a much more uniform approach to boundaries and reporting and better forecasting of the Business As Usual. The Higher Education sector is unusual within the public sector in that growth is seen as a positive outcome and encouraged. Therefore, there needs to be consideration to how that growth is driving changes in emissions before starting to think about what targets are realistic for the sector.

[8] Climate Change (Scotland) Act 2009 - www.legislation.gov.uk/asp/2009/12/contents

[9] www.keepscotlandbeautiful.org/sustainability-climate-change/sustainable-scotland-network/reporting-on-climate-change-duties/

- The Scottish Government Required Reporting Order for the Climate Change Duties will drive improvements in the data but will require institutions to manage carbon data more effectively, particularly in terms of project data and factors that impact on future emissions.
- As universities get to the end of their CMPs, there is evidence of a falling off in project identification and annual tasks e.g. effective footprint reporting. In order to drive ongoing reductions, the Carbon Reduction Project Register needs to be brought back to centre stage and updated quarterly.
- Previous and future projects demonstrate, to a certain extent, the likely make-up of the team that is driving carbon management within Institutions and in order for further opportunities to be identified, this team needs to be widened out to include other disciplines such as IT, procurement and travel.
- There needs to be an organisational shift where the responsibility for making carbon reductions is also put on other departments, staff and students, rather than being seen as something Estates will deal with.

There are still likely to be lots of reduction opportunities available. However, without much more detailed analysis, it is not easy to offer a couple of 'fix all' technological solutions that should be implemented in all institutions. It is also a high risk strategy to rely on massive breakthrough in terms of technologies e.g. looking for novel solutions.

There are ongoing improvements in technology, especially in terms of cost effectiveness e.g. the energy efficiency of technologies improves or the unit cost comes down. It is important that universities keep on top of these possibilities and communicate to the sector when something becomes relatively inexpensive and works for them. Examples are likely to be found in IT, lighting, catering and renewables. However, there are other strategies that could also be employed alongside:

- Putting more resources into detailed data analysis is likely to identify unseen opportunities. Energy data collection and resolution has increased hugely in the past ten years but few institutions resource the analysis of this dataset sufficiently and therefore there are likely to be missed opportunities.
- Higher education establishments have the challenge of a population of users who change frequently but also have the potential for high engagement and ideas. Leveraging the opportunities of the students and staff population to engage them with carbon management and increase its profile and importance within the university also is likely to produce opportunities.
- There was an interview with Dave Brailsford, British Cycling's performance director[10] and a question was asked about the 'marginal gains' that underpin everything the team did. His response was simple; "*The whole principle came from the idea that if you broke down everything you could think of that goes into riding a bike, and then improved it by 1%, you will get a significant increase when you put them all together*". Because carbon emissions come from lots of small sources, the same approach can be applied to energy use/carbon emissions within an organisation or, better still, a single building. This is where 'awareness' projects can succeed, as part of a technological/behavioural suite of changes.

[10] August 2012, http://www.bbc.co.uk/sport/0/olympics/19174302