# UTILITIES REPORT

## PERIOD AUGUST 2012 TO JULY 2013

## University of Aberdeen

Contents



Utilities Report in Numbers – This separate document contains the breakdown of the utility consumption by individual buildings.

Figures



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# 1 Executive Summary

For the financial year 2012/2013, the University purchased 107,104,827 kWh[1] of energy, for Academic and Campus Services buildings, at a cost of £5,575,593. This energy use resulted in emissions of 27,017 tonnes of Carbon Dioxide. Further the University used 251,049 $m^3$ of water at a cost of £579,744. The overall cost for utilities for the year was £6,155,377. For gas and oil there was an increase in consumption primarily due to a colder winter. Electricity reduced due mainly to the refurbishment of the Edward Wright Data Centre. Overall there was an increase in energy consumption at the University and corresponding increase carbon emissions compared with 2011/2012 this equated to an increase of 3.7% or 970 tonnes.

# 2 Energy as Supplied Summary

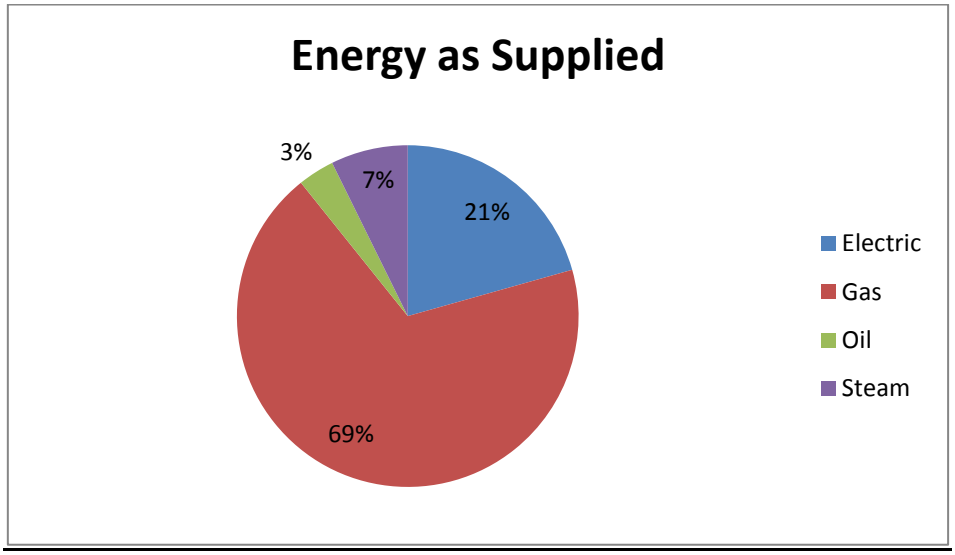
The information on energy is reported on two separate bases. The first is the energy supplied to the University. The second is the actual energy used on site. The reason for this is because the University uses a Combined Heat and Power station to generate electricity on site. Therefore some of the gas supplied to the site is used to generate electricity. The result is that there is less apparent gas use for the energy used by buildings than that supplied to site, while at the same time there is more apparent electricity use.

The table below details the energy as supplied to the site. The actual energy use within buildings is detailed in the separate document Utilities Report in Numbers. Overall energy consumption as supplied increased by 6.6%, and the actual cost of energy increased by 22.5%.

**Table 1 Energy as Supplied**

| Energy | Consumption, kWh | Cost, £ |
|---|---|---|
| Electricity | 20,939,758 | 2,307,123 |
| Gas | 75,535,688 | 2,450,285 |
| Oil | 4,766,944 | 372,166 |
| Steam | 5,862,437 | 446,019 |
| Total | 107,104,827 | 5,575,593 |

**Figure 1 Energy as Supplied**




[1] kWh equates to Kilo Watt Hour

## 3 Carbon Dioxide Emissions – Actual for 2012/2013

The University has developed a 5 year Carbon Management Plan 2009-2014, with the aim of reducing carbon dioxide emissions by 20%. Arising from developing the plan it was identified that energy use in buildings contributes over 80% of the University's carbon dioxide emissions. Based on the energy as supplied to site the associated Carbon Dioxide emissions for 2012/13 are calculated as per the table below.

**Table 2 Carbon Dioxide Emissions**[2]

| Energy | Consumption, kWh | $kgCO_2/kWh$ | Tonnes $CO_2$ |
|---|---|---|---|
| Electricity | 20,939,758 | 0.48890 | 10,237 |
| Gas | 75,535,688 | 0.18450 | 13,938 |
| Oil | 4,766,944 | 0.27180 | 1,296 |
| Steam | 5,862,437 | 0.26360 | 1,546 |
| Total | 107,104,827 | | 27,017 |

## 4 Carbon Dioxide Emissions – Performance against Targets

The Carbon Management Plan (CMP) sets targets reducing carbon emissions by 20% over 5 Years. The carbon figures have been re-calculated for the five years of the plan for electricity based on guidance from Defra which now provides the conversion factors on an annual basis. The conversion factor for gas has been similarly amended to that for the Gross Calorific Value of the fuel in line with Defra's guidelines. The base year emissions were 25,778 tonnes, and the emissions for the current year were 27,017 tonnes. This is an increase in carbon dioxide emissions, arising from energy use in buildings, of 1,238 tonnes or 4.8%

**Figure 2 Carbon Emissions Graph based on CMP**[3]

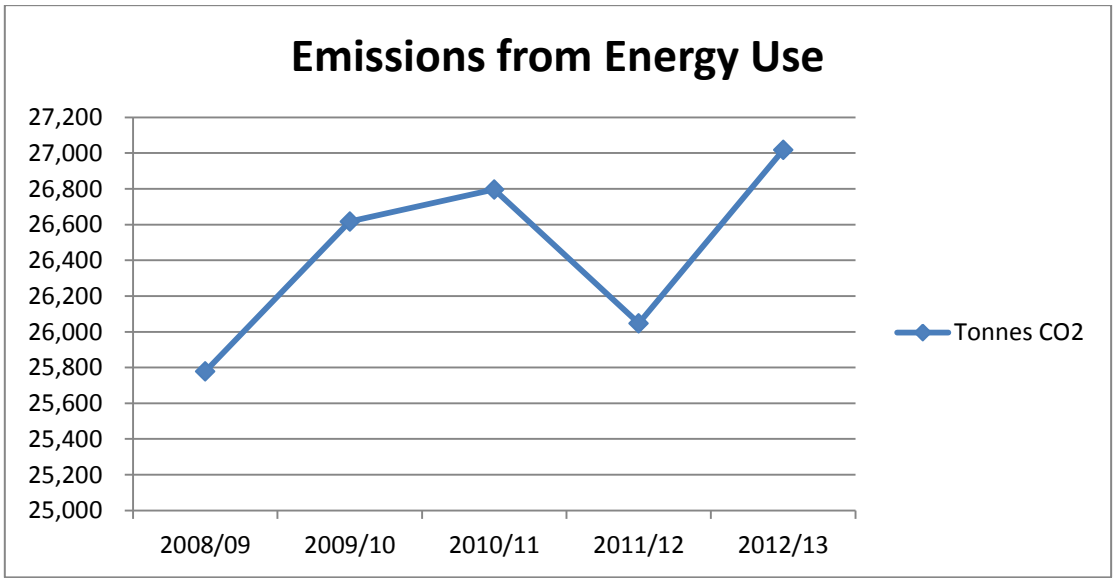



**Table 3 Carbon Emissions History**

| Year | 2008/09 | 2009/10 | 2010/11 | 2011/12 | 2012/13 |
|---|---|---|---|---|---|
| Tonnes $CO_2$ | 25,788 | 26,617 | 26,796 | 26,047 | 27,017 |

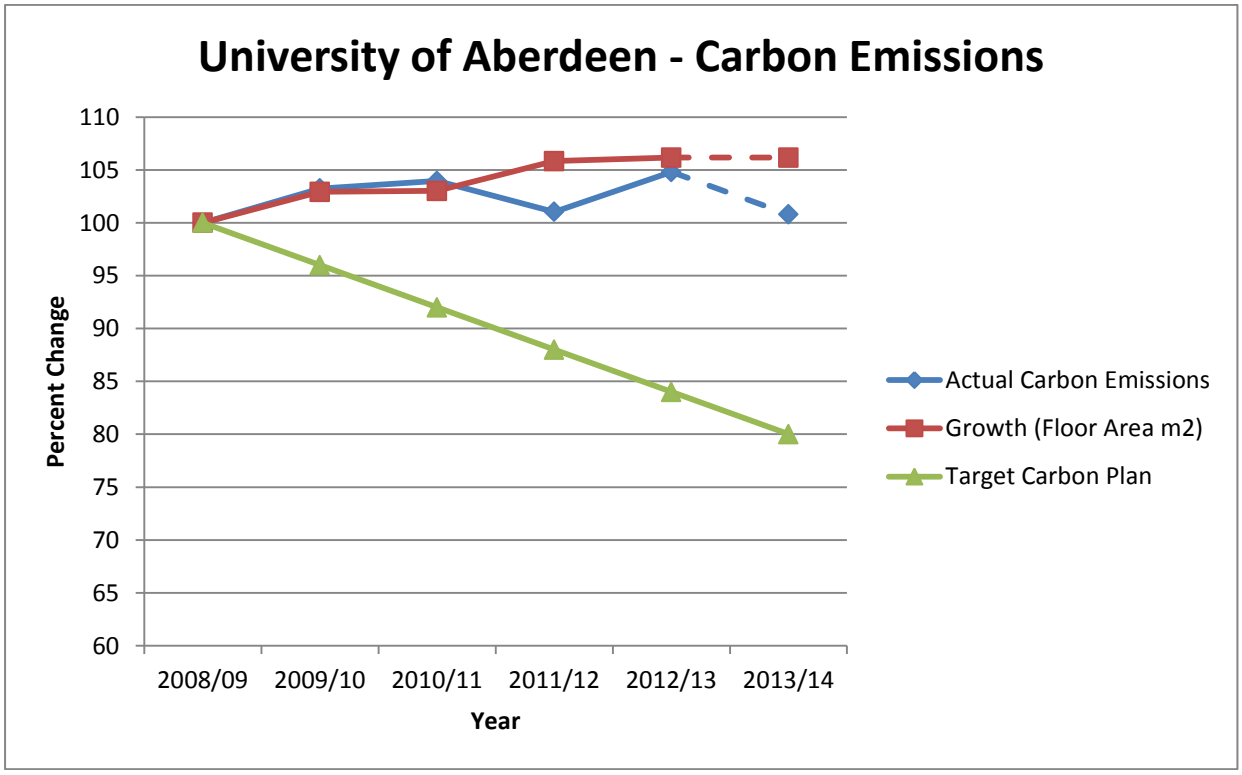
[2] The conversion factors used (kgCO2/kWh) are based on those quoted in the "Guidelines to Defra's Greenhouse Gas (GHG) conversion factors for company reporting".

[3] The target for reducing carbon dioxide emissions is an absolute target and changes to the size of the estate, either increase, or reduction will affect the actual emissions, but will not result in a change to the target.

Achieving the target level of carbon dioxide emissions required continues to be extremely challenging. One of the reasons for this is that the University is experiencing a period of growth as detailed in the section on occupancy of buildings as detailed below. Bearing these factors in mind, in addition to reducing energy use, the University is increasingly investigating the possible options for renewable energy projects.

Occupancy of Buildings

The buildings that the University uses change each year with new buildings coming on line, and old buildings closing. In 2008/09 the University occupied 240,040 m2, and this has increased to 254,828 m2 in 2012/13. The result is an increase in floor area of 6.2%. This growth in the Estate tends to result in increased carbon dioxide emissions from the University's building stock. This factor is one of the reasons why, where new buildings are developed by the University, they are required to be more energy efficient than previous buildings. The graph below demonstrates how the University is doing against the target for reducing carbon emissions and the effect of the increasing size of the Estate.




The new buildings that started operation in 2012/13 are detailed below.

The Life Sciences and Innovation building (LSI 1): This building used to be operated directly by Wyeth and was therefore not included as part of the University buildings for carbon reporting. The building returned to University operation in May 2012, and is now included in the emissions reporting.

New Carnegie, Hillhead: The University has taken responsibility for this building off Unite. The building has operated as a University building since December 2012. As the building has only been in operation for part of the year it has not been included in the floor area figures above.

90 High Street: The University has purchased 90 high Street and plans to re-develop this building. As the building has only been in operation for part of the year it has not been included in the floor area figures above.

## 5 European Union Emissions Trading Scheme (EU-ETS)

The Combined Heat and Power station exceeds 20MW capacity and is covered by the EU-ETS. As a result the University reports on emissions arising from use of gas and oil at the Old Aberdeen Campus. Under this scheme a number of allowances are allocated to the University for this Site each year, with one allowance being equivalent to one tonne of carbon dioxide. To establish the allocation, an average of 4 years emissions was assessed, this came to 8,148 tonnes. The allocation received under the scheme was 6,924 allowances (a 15% reduction). The reporting year under EU-ETS is January – December.

- Historical Average Emissions 8,148 tonnes
- Actual Emissions 2012 9,036 tonnes
- Allowances 2007 basis 6,924
- Excess Emissions 2,112 tonnes

The University target for EU-ETS allocations is to reduce emissions in line with the number of allocations received. For the calendar year 2012 the University exceeded the number of allowances by 2,112 tonnes. It was necessary to purchase allowances to make up the shortfall and this cost £7,768. The UK in conjunction with the European Union has recently introduced an Opt Out Scheme for small emitters that are sites that have an installed thermal capacity of less than 35MW. The site capacity for the CHP station is less than this threshold and the University is due to move in to the opted out scheme from 1st January 2013. The number of allowances the University will be allowed in 2013 is 7,679 tonnes.

## 6 Carbon Reduction Commitment (CRC) scheme

The Carbon Reduction commitment Scheme was in the third year of operation covering the period 1st April 2012 to 31st March 2013. The scheme and the total carbon emissions for the University falling within the boundaries of the scheme (the scheme excludes emissions reported under EU-ETS) was 21,844 tonnes. The charging rate to purchase allowances to cover these emissions was £12/tonne. The total cost for carbon emissions for the year was £262,128. These charges are in addition to the invoiced utility charges. This was a decrease in emissions of 93 tonnes or 0.4%.

# 7 Energy as Used

Energy used at the University has increased by 6.3% overall. While the headline figure is worse, breaking the energy consumption down by usage shows that progress is being made.

Electricity
The electricity consumption decreased by 100,000 kWh, or 0.3% from last year's consumption. This is the first fall in electricity consumption that the University has recorded since 2009/10. The main factor behind this drop in electricity consumption was the free-cooling project at the Edward Wright Data Centre which is detailed further in section 8. The savings from this project were partially offset by the University starting operation of New Carnegie, and by the LSI 1 building reverting to use as a University building.

Heating
The energy used for heating increased by 8.9% when compared with 2011/12, but the winter was 9.6% colder meaning there was a small net improvement in energy efficiency.

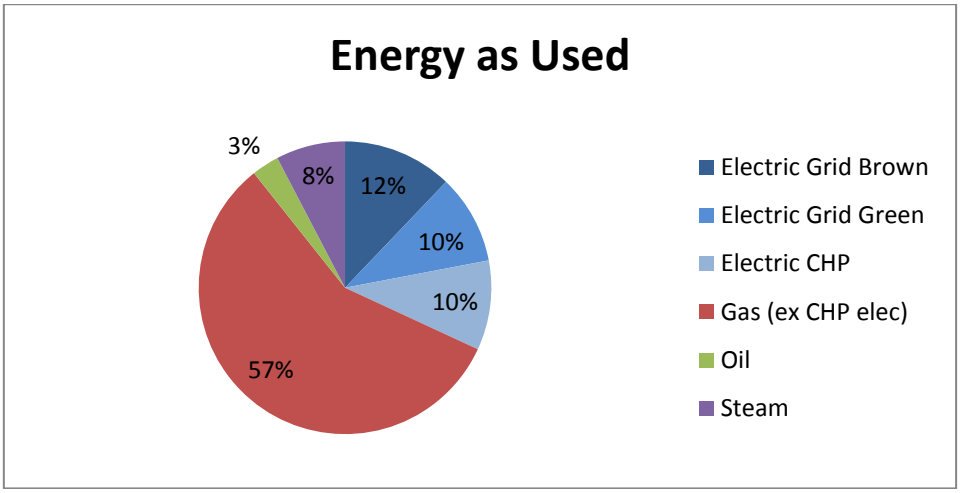
Metering
The University has continued to move to using systems to remotely read energy and water meters to obtain better data on how the buildings are performing. This has allowed for better identification of areas where there are issues like over consumption of utilities within buildings, and to readily quantify them. Examples of this are detailed in Section 8, and Section 13 of the report.

The actual energy use on site, and the relative proportions of the utilities used are detailed below in table 4 and figure 4:

**Table 4 Energy as Used**

| Energy as Used | Consumption, kWh | Percent of Overall Consumption |
|---|---|---|
| Electricity Grid - Green | 11,527,246 | 12% |
| Electricity Grid - Brown | 9,412,512 | 9% |
| Electricity CHP – Generated On site | 9,778,000 | 10% |
| Gas | 61,232,463 | 60% |
| Oil | 4,766,944 | 3% |
| Steam | 5,862,437 | 6% |
| Total | 102,579,602 | 100% |

**Figure 3 Energy as Used**




The proportion of utilities used has remained very similar to that for last year.

# 8 Energy Saving – Using Technology

During the course of the year a number of specific energy saving measures have been implemented. Some of these have been funded through Salix, and some are through core budgets. These measures have contributed to helping achieve an overall reduction in energy consumption and carbon emissions compared with last year

Free Cooling - Edward Wright Data Centre
The major saving in terms of reducing electricity consumption, at the University has been the complete redevelopment of the Data Centre in the Edward Wright Building lead by IT Services. The servers were all replaced and the internal floor and ceiling replaced. The equipment and fittings were arranged to give “hot” and “cold” aisles to allow different temperature zones for supply and extract air. This in turn means the air does not need to be mechanically cooled until the extracted air exceeds a higher temperature than would be possible with a conventional system. It is anticipated there will only be a requirement for additional cooling for about 4 months of the year. The system has reduced the air-conditioning load by in excess of 80%. The projected annual savings are 1,138,800 kWh, 612 tonnes CO2, and £94,000.

Actual Performance:


The graph above demonstrates that the electricity consumption reduced from that need for mechanical cooling to only the amount of fan power required to ventilate the data centre. Electricity use dropped from 1,100 kWh/day to 200 kWh/day or by 82%.

Freezer and Fridge Motor Controls – IMS, Polwarth, and Zoology Buildings
The University has several hundred -20 freezers and +4 fridges. The motor control on these units does not modulate to match the energy required, and as a result energy is wasted. Savawatt motor control devices were fitted to each of these units. These controls adjust the electricity supply as required, and save energy.

Projected Annual Savings: 186,280 kWh, 97 tonnes CO2, £14,869
Installed Cost: £38,132
Payback: 2.6 years

Actual Performance: The savings were determined by calculation.

Insulation of Hot Water Pipe Work – William Guild
This was a small job where insulation on a section of hot water pipe work at William Guild needed to be replaced.

Projected Annual Savings: 50,037 kWh, 9 tonnes CO2, £1,626
Installed Cost: £6,510
Payback: 4.0 years

Actual Performance: The savings were determined by calculation.

Insulation of Steam Main - Polwarth
A length of steam main was replaced at the Polwarth Building and this was a separated project to insulate the pipework, and minimise heat losses

Projected Annual Savings: 100,246 kWh, 19 tonnes CO2, £3,258
Installed Cost: £14,599
Payback: 4.5 years

Insulation of Heating Pipe work – Butchart, Zoology
Some heating pipe work was uninsulated, and insulation was fitted to reduce heat losses.

Projected Annual Savings: 389,896 kWh, 72 tonnes CO2, £5,838
Installed Cost: £5,838
Payback 1.0 years

Insulation of Heating Pipe work – Crombie Annexe
A length of heating pipe work was uninsulated, and insulation was fitted to reduce heat losses.

Projected Annual Savings: 39,412 kWh, 7 tonnes CO2, £1,280
Installed Cost: £4,238
Payback 3.3 years

Replacement of Lighting – Fraser Noble
The 200 light fittings in the East wing were old and inefficient. The existing switch start fluorescent lighting was replaced with high frequency lighting that increased lighting levels while reducing electricity consumption.

Projected Annual Savings: 53,760 kWh, 28 tonnes CO2, £4,838
Installed Cost: £21,594
Payback: 4.5 years

Actual Performance: The savings were determined by calculation.

Replacement of Electric Heating – Elphinstone Road Flats
The heating in Elphinstone Road Flats was previously provided by electric heaters. A project to replace this with a wet radiator system has been carried out and the heating is now supplied off the Old Aberdeen CHP station. Work was completed on this section of the works Sep13.

Projected Annual Savings: 117 tonnes CO2, £32,747
Installed Cost: £163,000
Payback: 4.9 years

Actual Performance: The savings were determined by calculation.

Overall saving from Energy Technology
The total reduction in carbon emissions arising from these measures is projected to be 844 tonnes p.a. (excludes Elphinstone where the work has not been completed). This is equivalent to a 3.3% reduction in carbon dioxide emissions.

## 9 Energy Saving – Staff Awareness/Good Housekeeping

The need to reduce energy consumption with a view to reducing carbon dioxide emissions has only been promoted to a limited extent during the course of the current year. Stands have been set up at the Freshers Fayre, and the Engineering Applicant day. The University again signed up to, and took part in Earth Hour with decorative lights being turned off around King's College

Work has continued in partnership with the Climate Challenge Project on the series of Carbon Conversation talks to raise awareness among students.

Information has been displayed on notice boards during the year, and articles posted in Readable including the introduction of the Carbon Reduction Commitment (CRC) that adds approximately £250,000 p.a. to the utilities costs at the University.

## 10 Combined Heat and Power Station (CHP)

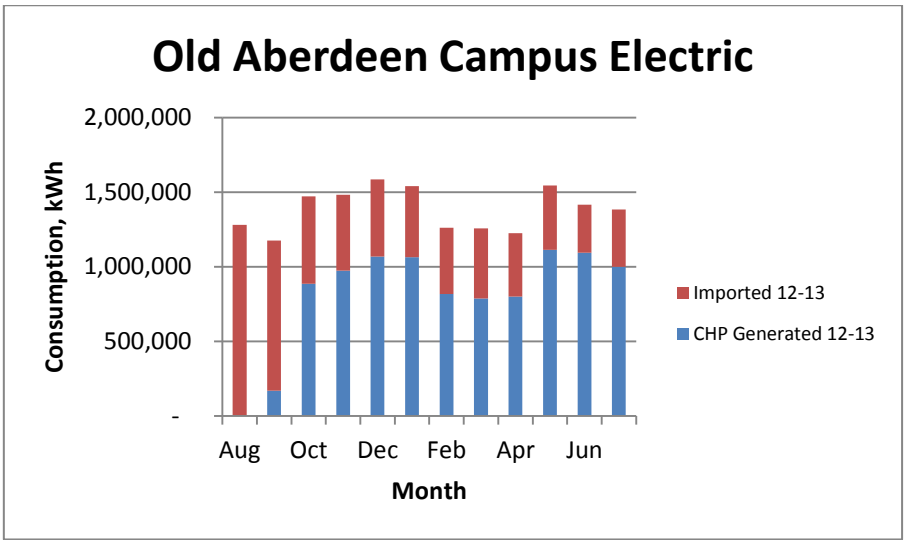
The Combined Heat and Power station commenced operation in May 2007. The CHP station is a supply side measure to reduce carbon dioxide emissions from energy use at the University. The CHP station reduces carbon dioxide emissions due to the plant by using the waste heat from generating electricity to heat the University's buildings. The result of this is that the CHP has a higher overall operating efficiency compared with that of a conventional power station. A further benefit is that it reduces the cost of electricity.

The CHP engine was operated for longer hours during the year 12/13, producing more electricity and reducing carbon emissions. The revisions to the building heating controls implemented in 2011 continue to result in lower return temperatures to the CHP station increased the ability to use the CHP engine in times when the heating demand was less.

The CHP engine generated 58% of the electrical load for the Old Aberdeen Campus. This is shown in the figure 3. The effect of generating electricity using the CHP engine was to reduce the average overall price for electricity at the site from 12.92p/unit to 9.04p/unit.

Overall the implementation of the CHP scheme has resulted in a cost saving of £333,000, and a reduction in emissions of 2,148 tonnes, for the year.

**Figure 4 Old Aberdeen Campus electricity consumption for period 2012/13**




Foresterhill CHP Connection

Historically a number of the University Buildings at the Foresterhill campus have been connected to the NHS Trust for supplies of steam to produce heating and hot water. The NHS Trust has upgraded the central heating station in to a Combined Heat and Power (CHP) Station. With this development the majority of the University buildings on the site have been connected to the CHP station for supplies of electricity. One of the benefits of taking the electricity supplies off the CHP station is that the distribution losses associated with the grid are eliminated reducing the rate of emissions from electricity from 0.489 kg CO2/kWh to 0.452 kg CO2/kWh. This has resulted in a reduction in carbon dioxide emissions associated with energy use in these buildings of 226 tonnes.

# 11 Installation of Renewable Energy Technology

Renewable energy sources are a supply side measure that can be used to reduce carbon dioxide emissions from energy use at the University. The amount of installed capacity is currently very low, but there are plans to increase the use of renewables going forwards.

The Sir Duncan Rice Library has 50m2 of solar photovoltaic panels on the roof. This is currently the total capacity of renewable energy that the University has installed, but it has generated electricity in line with that predicted. This provides proof of the technology, and further installations are now planned. The energy generated from these is recorded on the remote meter reading system and this is displayed in the graph below.

**Figure 5 Library Solar PV Electricity Output**

The graph shows that in during 2012/13 the solar panels are on target to generate the majority of the projected 7,787 kWh of electricity for the year, reducing carbon emissions by 4 tonnes.

Going forwards the University is looking at 2 possible renewables projects:

1) Solar Panels for Burnett and Esselmont
   The proposal to install solar panels on Burnett and Esselmont has been accepted, and will go ahead as part of the refurbishment works scheduled for Summer 13. These Photovoltaic PV) panels will generate approximately 157,000 kWh p.a. in total. This equates to about 30% of the electricity used in these residential blocks, and corresponds to a reduction in carbon emissions of 76 tonnes.

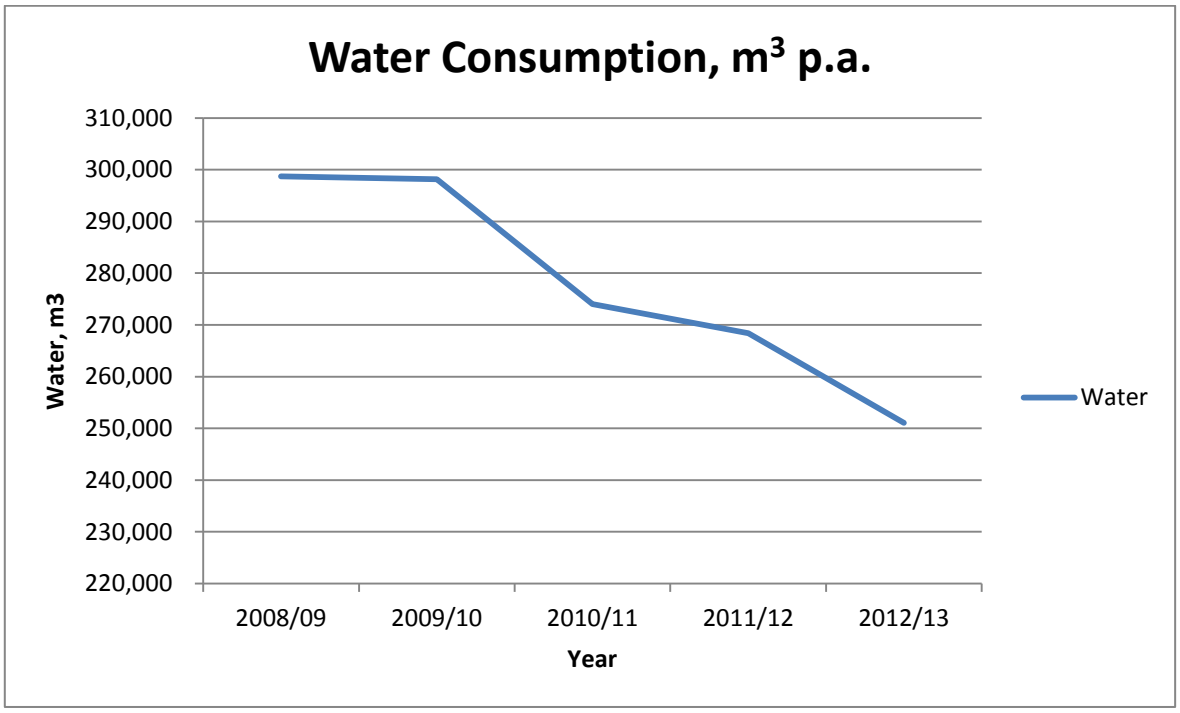
2) Biomass for CHP station, and Hillhead
   There is the potential to use Biomass to provide heating at the CHP station. The initial assessment based on installing one 999kW biomass boiler at each location. The potential carbon saving for each site is ~ 1,400 tonnes carbon for each location. The specification was worked up as an initial proposal to bid for part of an SFC fund. The application was ultimately unsuccessful. The values of the rates of Renewable Heat incentive (RHI), dependant on boiler size were subsequently put under review by the Government, making it difficult to assess the best size of boiler to proceed with. The University will continue to evaluate the options for biomass at these 2 sites, and produce a financial assessment when the RHI level is confirmed.

## 12 Water Consumption

The University aims to reduce water consumption by 2% year on year. There has been significant progress in reducing water consumption at the University during 2012/13 with the water consumption having fallen by 6.4% year on year.

**Table 5 - Water Consumption and Cost**

| Utility | Consumption, $m^3$ | Cost, £ |
|---|---|---|
| Water | 251,049 | 167,927 |
| Sewerage | - | 411,817 |
| Total | 251,049 | 579,744 |




| Year | 2008/09 | 2009/10 | 2010/11 | 2011/12 | 2012/13 |
|---|---|---|---|---|---|
| Consumption, $m^3$ | 298,685 | 298,140 | 274,023 | 268,369 | 251,049 |

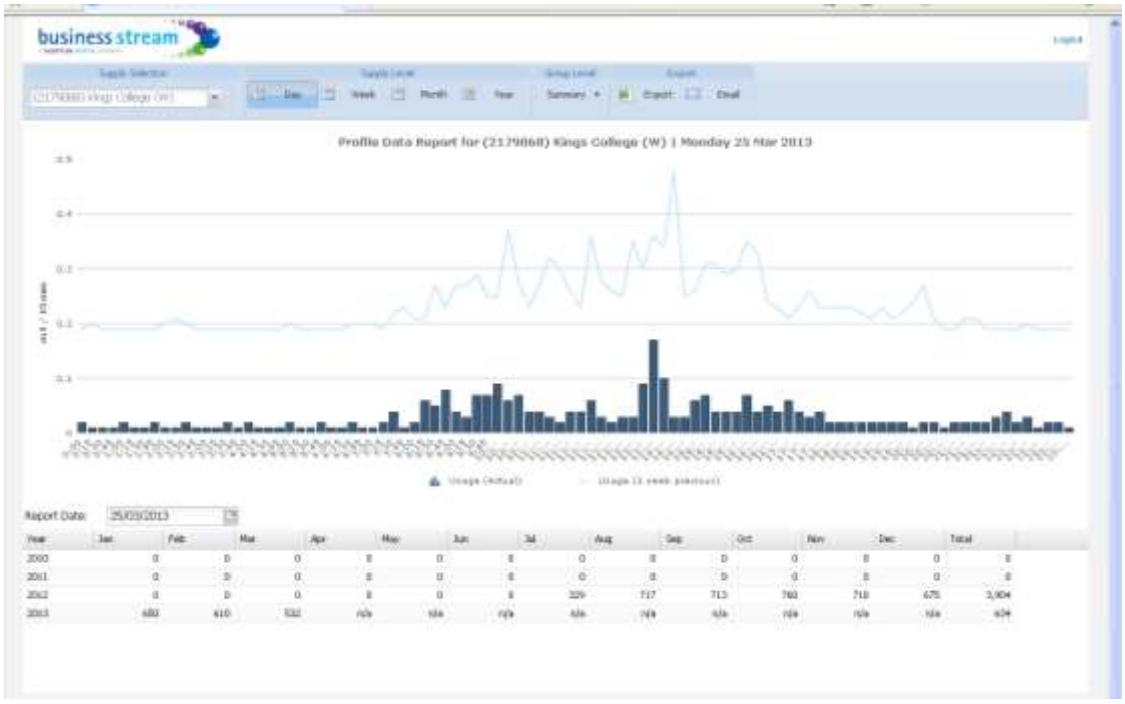
The 2% target has been achieved during 2012/2013.

## 13 Water Saving – Using Technology

Leak Kings College

The water use at Kings College was reviewed by checking the daily profile recorded by the Automatic Meter Reader (AMR) installed on the water meter. This showed that large volumes of water were used out of ours when the building was unoccupied. Scottish Water engineers identified sounds of a leak at the back of the Chapel. The area round the water main was excavated, and the leak found, at the same time the nearby drain was found to have been broken, and the water from the pipe was flowing in to the drain so no evidence of the leak was visible at ground level. The leak was repaired.

Projected Annual Savings 6,900 $m^3$, £13,800




Light Blue Line – Cons before repair
Dark Blue Columns – Cons after repair

<u>Toilet Flushing – SDR Library</u>

The New Library had sensors to operate the flushing mechanism for the toilet cisterns in the building. These were found to be too sensitive, resulting in the toilets flushing day and night. There is a dedicated meter for the water use in the toilets and this showed the problem clearly. The flush controllers were changed out for manually operated controls the graph below shows consumption in 2011/12 red line, and consumption in 2012/13 blue stacks.

Annual Saving 6,000 $m^3$, £12,000


Red Line – Cons before change
Blue Columns – Cons after change

## 14 Water Saving - Staff Awareness/Good Housekeeping

A key factor for water is that if a building is unoccupied, then in the majority of cases the water consumption can be expected to drop to close to zero. When metering data is reviewed, if there is out of hours use then there is the potential to discuss with staff if there is a requirement for water use at these times, and if not, then identify what the issue may be.

## 15 Grey water/Rainwater harvesting

The rain water harvesting system in the SDR Library contributed approximately 10% of the buildings water needs.