

ENERGY REPORT

PERIOD AUGUST 2015 TO JULY 2016

University of Aberdeen



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Executive Summary

For the academic year 2015/2016, the university purchased 107,612,476 kWh of energy, for Academic and Campus services buildings, at a cost of £3,756,487. This energy use resulted in 25,669 tonnes of CO₂ being emitted. Once the consumption and cost of the university's water usage (295,023m³ and £647,742 respectively) is taken into account, the overall cost of this year's utilities was £4,404,229.

Overall there was an increase of 3.4% in energy consumption at the university but there was a decrease of 2% or 523 tonnes in CO₂ emissions.

Energy as Supplied Summary

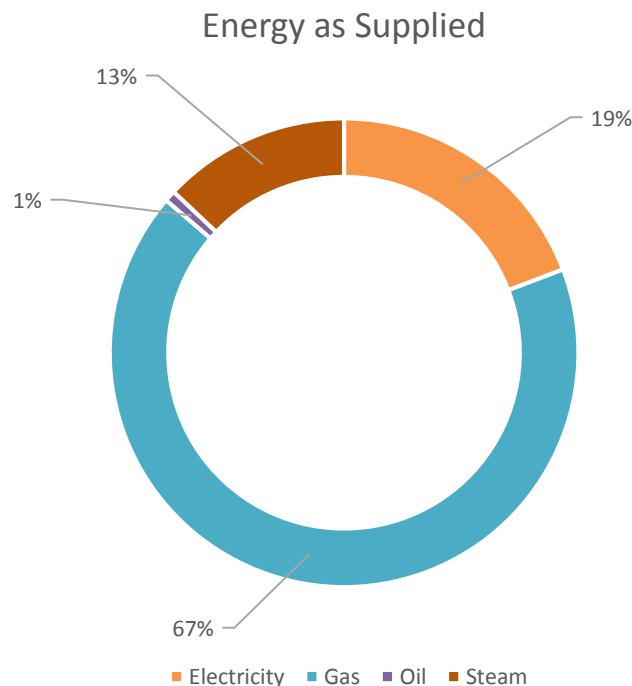
The information on energy is reported on two separate bases. The first is the energy supplied to the University and the second is the actual energy used on site. The reason for this is that the University uses a Combined Heat and Power station to generate electricity on site. Gas supplied to the site 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. Overall energy consumption as supplied increased by 3.4%, and the cost of this energy decreased by 18.7% from the previous year.

Table 1 Energy as Supplied

Energy	Consumption (kWh)	Cost (£)
Electricity	20,321,521	1,518,102
Gas	72,754,878	1,693,228
Oil	840,707	32,038
Steam	13,695,370	513,120
Total	107,612,476	3,756,487

Figure 1 Energy as Supplied



Carbon Dioxide Emissions – Actual for 2015/2016

Based on the energy as supplied to site, the associated Carbon Dioxide emissions for 2015/16 are calculated as per the table below.

Table 2 Carbon Dioxide Emissions

Energy	Consumption, kWh	kgCO ₂ /kWh	Tonnes CO ₂
Electricity	20,321,521	0.4493	9,130
Gas	72,754,878	0.1840	13,387
Oil	840,707	0.2467	207
Steam	13,695,370	0.2150	2,945
Total	107,612,476		25,669

Carbon Dioxide Emissions – Performance against Targets

The 2009/14 Carbon Management Plan had a baseline year of 2008/09 with 25,778 tonnes of CO₂. While the Carbon Management Plan is completed, it still provides a good baseline to chart the progress of reducing emission levels. A new Carbon Management Plan is in the process of being finalised and proposes to utilise the 2015/16 consumption data as a benchmark

This year's emissions are 25,669 tonnes which is a 0.5% decrease on the baseline and a 2% decrease on the previous year's emissions. While this year hasn't produced the lowest level of emissions, it is still an improvement on 2014/2015 and this year the IMS building has been included for the first time, and we did not generate our own electricity at the Old Aberdeen campus for approximately 10 weeks – due to engine servicing.

Figure 2 Carbon Emissions Graph based on CMP¹

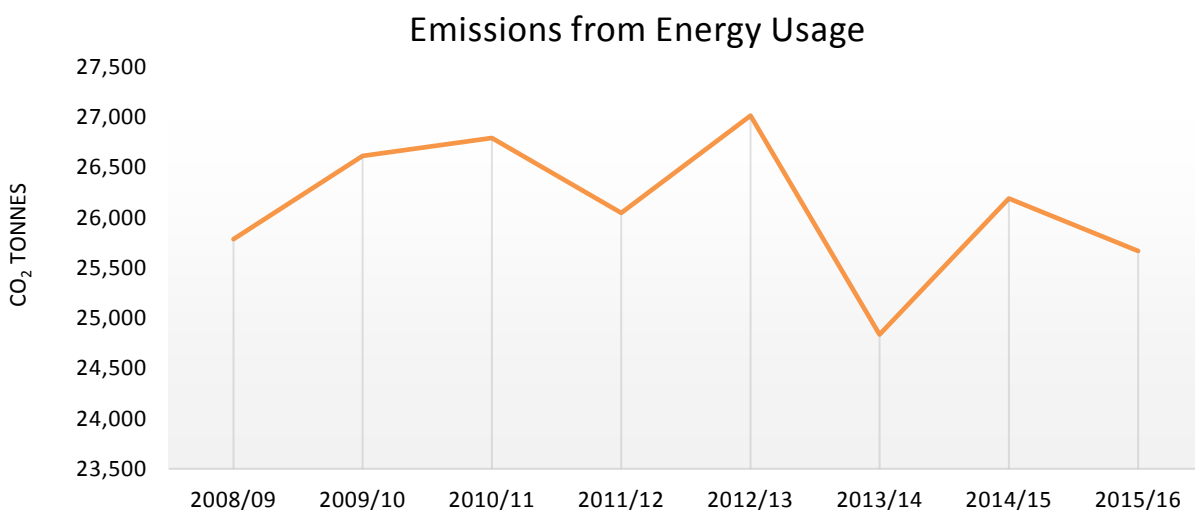


Table 3 Carbon Emissions History

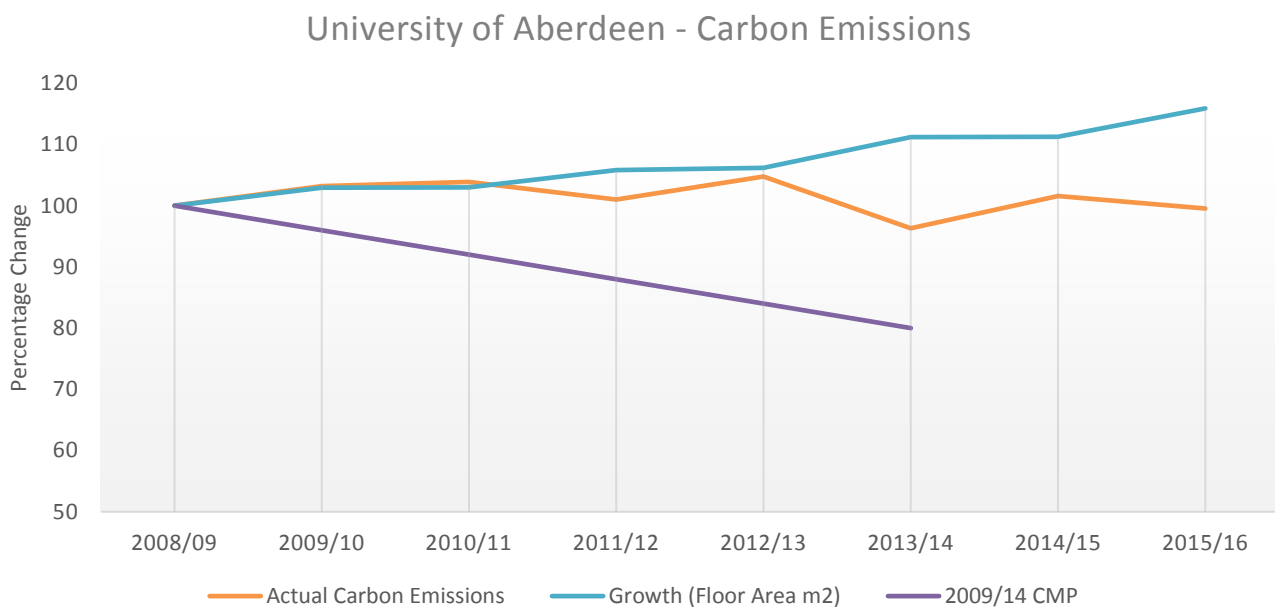
Year	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16
Tonnes CO ₂	25,788	26,617	26,796	26,047	27,017	24,837	26,192	25,669

¹ 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. It is also important to note that the new Energy Manager was appointed in September 2015 and a large focus of activity this year has been a data cleanse and greater use of our Energy Monitoring and targeting system (Optima). This has highlighted some omissions from previous year's data analysis, e.g. IMS building not being included in this report in previous years.

Occupancy of Buildings

The buildings that the University uses changes each year with new buildings coming on line, and old buildings closing. In 2014/15 the University occupied 267,035m², and this has increased to 278,211m² in 2015/16. The result is an increase in floor area of 4%. This growth in the Estate tends to result in increased carbon dioxide emissions from the University's building stock. As a result, when 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 performing against the target for reducing carbon emissions and the effect of the increasing size of the Estate.



The new buildings that commenced operation in 2015/16 are detailed below:

- The new Rocking Horse Nursery: In September 2015 the nursery staff moved to the new facility from the original Rocking Horse Nursery building. The new location is the first "early years" setting in Scotland to be built using the Passivhuas design.
- The new Rowett Institute of Nutrition and Health: In April 2016 the new 10,000m² Rowett building opened in the university's medical school campus. Worth noting here also that both the Old and New Rowett Buildings were operational simultaneously to towards the end of 2016.

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 for 2015 was 7,397 allowances (a 9% reduction). The reporting year under EU-ETS is January – December.

- Historical Average Emissions 8,148 tonnes
- Actual Emissions 9,446 tonnes
- Allowances 7,397 tonnes
- Excess Emissions 2049 tonnes

The University target for EU-ETS allocations is to reduce emissions in line with the number of allocations received. This is always challenging as the targets for reductions are arbitrary in nature. Civil penalties are imposed on the University for failing to meet the target and this year the financial penalty was just short of £10,000.

Carbon Reduction Commitment (CRC) scheme

The Carbon Reduction commitment Scheme was in the 8th year of operation covering the period 1st April 2015 to 31st March 2016. 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 10,009 tonnes. The total cost for carbon emissions for the year was £170,000. These charges are in addition to the invoiced utility charges. This was a decrease in emissions of 1,183 tonnes or 11% against the previous year.

Energy as Used

Energy used at the University has decreased by 16.4% overall in this financial year. This large drop is mainly due to energy saving methods being applied to the CHP station as well as a significant reduction in gas usage due to CHP servicing.

Electricity

The electricity consumption for 2015/16 decreased by 1,547,635 kWh or 5.1% from last year's consumption.

Gas

The gas consumption used for heating has decreased by 18,653,610 kWh or 34% since last year. This is due to the improved CHP operating techniques which have resulted in less heat being dumped and as a result less gas is required – remembering that the engine service will have reduced gas consumption as well.

Metering

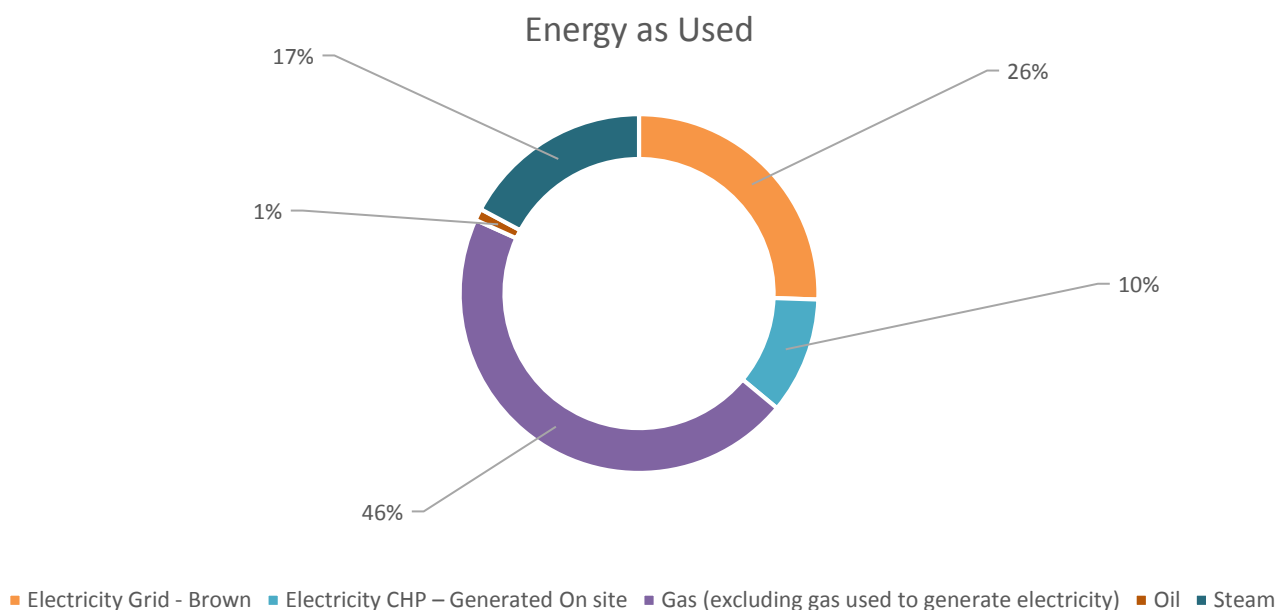
The University has continued to move to using systems to remotely read energy meters to obtain better data on how the buildings are performing. This has allowed for better identification of areas where there are issues over consumption of utilities within buildings. This data is used to inform our M&T system which has been instigated this year.

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)
Electricity Grid - Brown	20,321,521
Electricity CHP – Generated On site	8,356,800
Gas (excluding gas used to generate electricity)	36,377,439
Oil	840,707
Steam	13,695,370
Total	79,591,837

Figure 3 Energy as Used

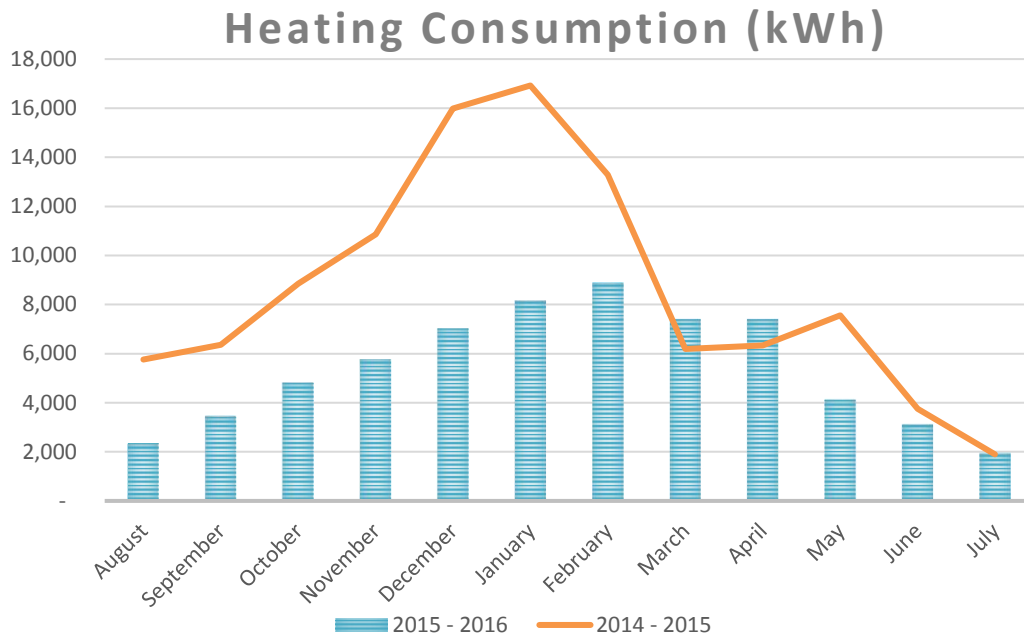


Energy Saving – Using Technology

During the course of this year a number of specific energy saving measures have been implemented. These measures have contributed to helping achieve an overall reduction in energy consumption and carbon emissions compared with last year

Chaplaincy Heating Schedule

As the majority of the Chaplaincy building is not in constant use, the Energy Management Team implemented a weekly updated heating schedule to match occupancy. This replaced the old heating timetable of 6AM – 10PM seven days a week. This measure results in savings of 41,118 kWh, £561.47 and 7.6 tonnes of CO₂



University Office Courtroom and Reception

The light fittings in the reception and Courtroom were inefficient for the space. The existing lamps were replaced with energy efficient LEDs.

Projected Annual Consumption Saving: 3,801 kWh

Projected Annual Financial Saving: £342.11

Projected Annual Emissions Saving: 1.71 tonnes

Bulkheads

Some bulkhead light fittings in place across campus needed upgrading so energy efficient lamps were installed.

Projected Annual Consumption Saving: 2,002 kWh

Projected Annual Financial Saving: £180.18

Projected Annual Emissions Saving: 0.9 tonnes

Emergency Lights

The emergency light fittings across campus were inefficient and required an upgrade.

Projected Annual Consumption Saving: 7,076 kWh

Projected Annual Financial Saving: £636.85

Projected Annual Emissions Saving: 3.18 tonnes

CHP Heat Exchanger and Secondary Pump Control

The existing heat exchanger's operation was compromised by the presence of debris and this was effecting the efficiency so a new one was installed. The control of the secondary pump was improved also to reduce wastage.

Projected Annual Consumption Saving: 966,200 kWh

Projected Annual Financial Saving: £13,193.46

Projected Annual Emissions Saving: 178 tonnes

Crombie Hall Boiler Room

A selection of uninsulated pipework and valves in the boiler room has been insulated

Projected Annual Consumption Saving: 15,556 kWh

Projected Annual Financial Saving: £719

Projected Annual Emissions Saving: 2.9 tonnes

Overall saving from Energy Technology

The total reduction in carbon emissions arising from these measures is projected to be 186.69 tonnes p.a. This is equivalent to a 0.76% reduction in carbon dioxide emissions.

It is worth noting at this juncture that a number of other projects have been implemented by the projects department and many of these have had a positive effect on the energy efficiency of our buildings – unfortunately a comprehensive list of projects carried out was not available at the time of writing.

Energy Saving – Staff Awareness/Good Housekeeping

Energy Awareness Campaign

From April 2016 the Energy Manager produced a weekly Energy Awareness segment to be included in the weekly Estates Newsletter. As of July 2016, the segment is also included in the weekly StaffNet Newsletter.

Overall saving from Staff Awareness/Good Housekeeping

As the awareness campaign started late on in the year and it included advice for the workplace and home, it is difficult to quantify any savings made to date. The articles have generated significant interest from the university population and it is the intention that this will be sustained with further awareness campaigns in 2016/17 to highlight this important issue to the wider University population.

Energy Consumption League Tables

This year £3,211,330 was spent on supplying electricity and natural gas to university buildings throughout the North East of Scotland.

Each building's energy consumption has been recorded throughout the year to enable an energy consumption league table of all the university buildings to be compiled.

The 2016/21 Carbon Management Plan contains a list of energy saving projects, with a number of them applying to the 10 highest energy consumers.

Electricity League Table

The IMS and SDR Library are the highest consumers of electricity on campus, and with no energy saving projects being identified for them in the Carbon Management Plan there is no indication that this will change in the coming year.

There have been 4 projects identified in the Carbon Management Plan that will reduce Zoology's, MacRobert's and the Meston Extension's energy consumption by 371,965 kWh in total.

Position	Location	Consumption (kWh)	Number of CMP Projects	Total Saving (kWh)	% Saving	Consumption after Projects (kWh)
1	IMS	4,314,062	-	-	0	4,314,062
2	New Library	2,011,055	-	-	0	2,011,055
3	Zoology	1,824,817	2	251,309	13.8	1,573,508
4	Hillhead Hall	1,801,986	-	-	0	1,801,986
5	MRF	1,675,371	-	-	0	1,675,371
6	MacRobert	1,387,896	1	92,916	6.7	1,294,980
7	Hillhead Carnegie	1,283,578	-	-	0	1,283,578
8	Edward Wright Data Centre	967,828	-	-	0	967,828
9	Meston Extension	919,140	1	27,740	3.0	891,400
10	Hub	890,517	-	-	0	890,517

Natural Gas League Table

The CHP station is expected to be one of the highest consumers as it requires natural gas to generate electricity and heat. However there has been a projected identified in the Carbon Management Plan that has the potential to produce a saving of 1,704,727 kWh or 3.8%.

The Hillhead Halls of Residence is the second highest natural gas consumer in the university. There is an opportunity to reduce this consumption by up to 1,024,846 kWh or 9.7% by implementing 8 projects in the Carbon Management Plan

Position	Location	Consumption (kWh)	Number of CMP Projects	Total Saving (kWh)	% Saving	Consumption after Projects (kWh)
1	CHP Station	45,225,366	1	1,704,727	3.8	43,520,639
2	Hillhead Halls of Residence	10,552,347	8	1,024,846	9.7	9,527,501
3	IMS	4,407,658	-	-	0	4,407,658
4	Medical Research Facility	4,066,081	-	-	0	4,066,081
5	Marischal College	1,979,062	-	-	0	1,979,062
6	Health Sciences Building	889,863	-	-	0	889,863
7	Rocking Horse Nursery	762,922	-	-	0	762,922
8	23 St Machar Drive (incl. Greenhouse)	728,144	-	-	0	728,144
9	Life Sciences Innovation 1	540,194	-	-	0	540,194
10	Oceanlab	382,811	-	-	0	382,811

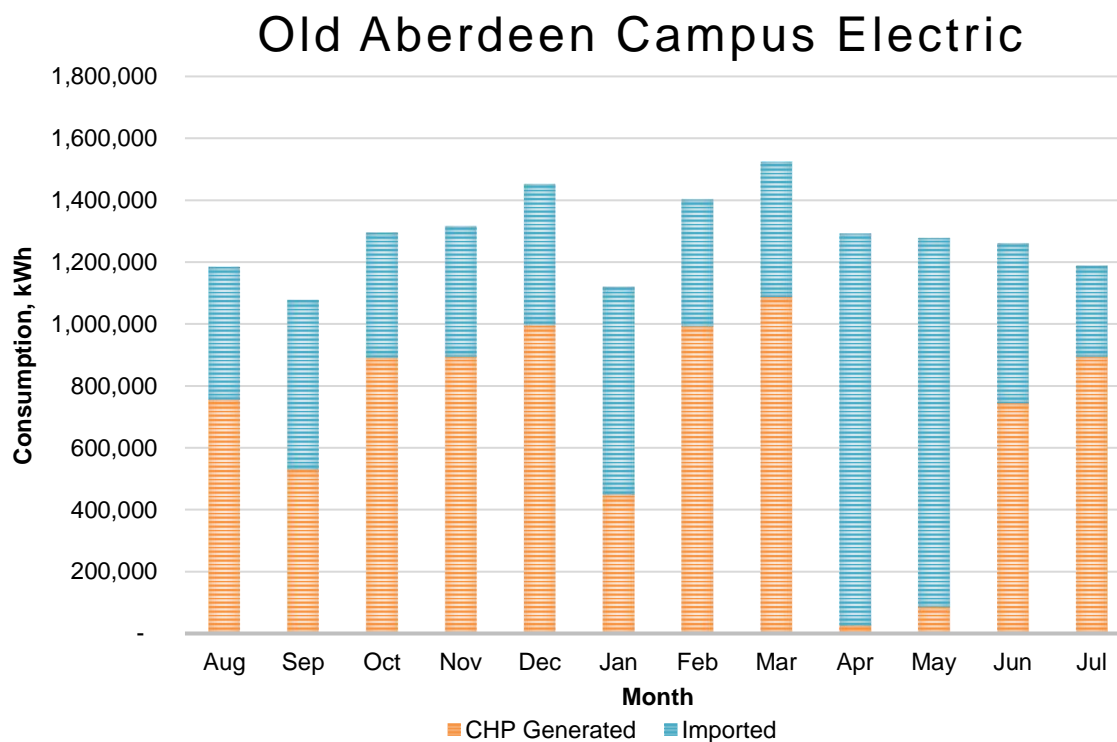
Combined Heat and Power Station (CHP)

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 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.

In April and May 2016 the CHP went offline for a major overhaul and the large majority of the electricity needs were provided by the national electricity grid as reflected in figure 3

The CHP engine generated 54.3% 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 11.06p/unit to 9.11p/unit.

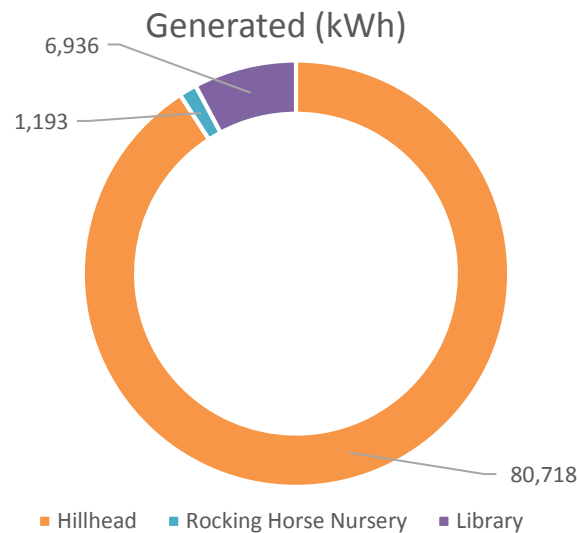
Figure 4 Old Aberdeen Campus electricity consumption for period 2015/2016



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.

There is currently 1,000m² of solar photovoltaic panels installed at Hillhead and 40m² installed at the Sir Duncan Rice Library and 12 m² of Solar Thermal installed at the new Nursery. The PV panels and the solar thermal system installed at the new Rocking Horse Nursery are the total renewable technologies capacity at the university.

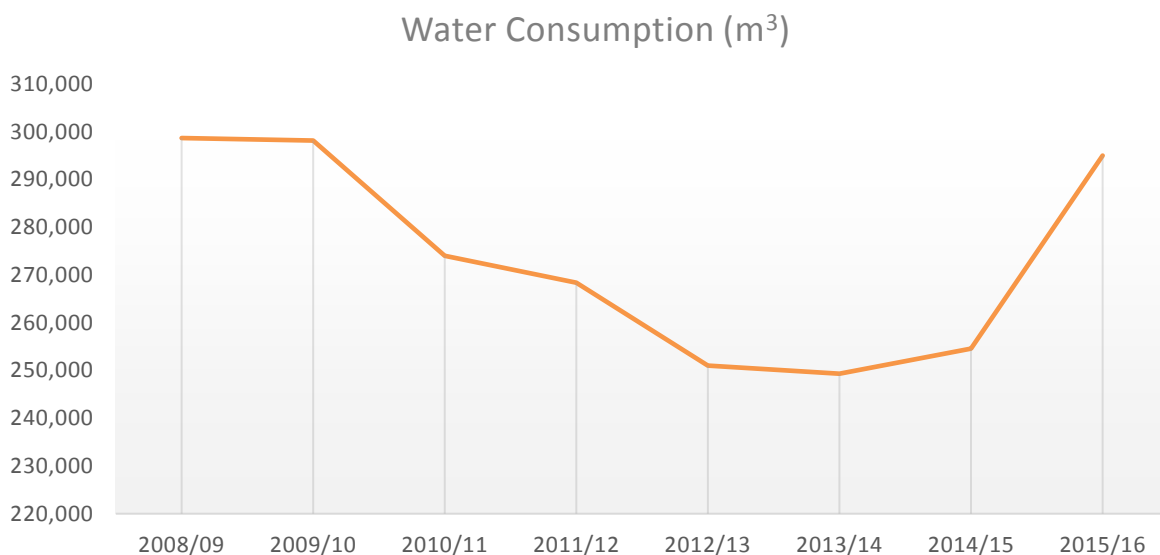


Water Consumption

The University aims to reduce water consumption by 2% year on year. There has been significant increase in water consumption at the University, this is mainly due to several buildings, including the IMS, being included in this report for the first time. It is important to note here that the university changed water supplier in March which has presented some issues with accurate billing.

Table 5 - Water Consumption and Cost

Utility	Consumption (m ³)	Cost (£)
Water (and Sewerage)	295,023	647,742.47
Total	295,023	647,742.47



Year	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16
Consumption (m ³)	298,685	298,140	274,023	268,369	251,049	249,321	254,600	295,023

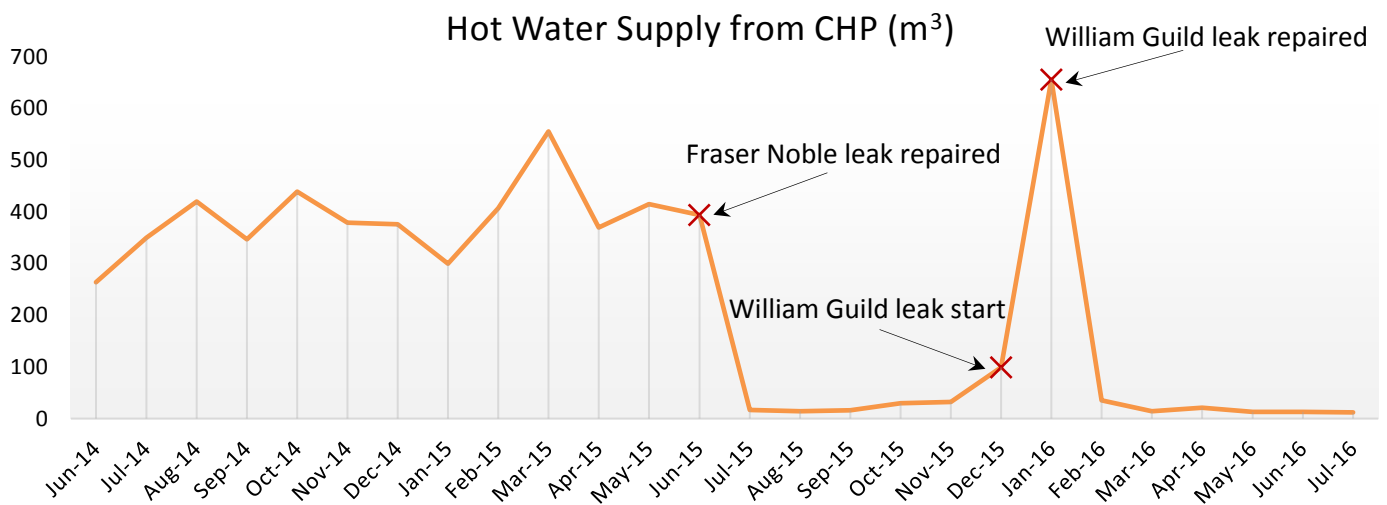
Water Saving – Using Technology

Fraser Noble Hot Water Leak Repair

A hot water pipe with a long term leak at the back of Fraser Noble was excavated and repaired at the beginning of June 2015. This repair produced a minimum reduction of 90% on the monthly hot water demand from the CHP station.

William Guild Hot Water Leak Repair

A hot water pipe developed a leak in William Guild in December 2016 and it increased the supply from the CHP by 2087% in two months, it was quickly repaired by the following month.



Hub Cold Water Leak Repair

In September 2015 a cold water leak developed in the Hub building which resulted in 990m³ of water being lost before the repair occurred in January 2016. The delay in repair was due to the area being a construction site meaning access was difficult. The cost of the leak has been passed onto the contractor who caused the damaged to the pipework.

Overall Saving from technology

The repair of the Fraser Noble and William Guild leaks have reduced the hot water supplied from the CHP by 95%

Water Saving - Staff Awareness/Good Housekeeping

Energy Awareness Campaign

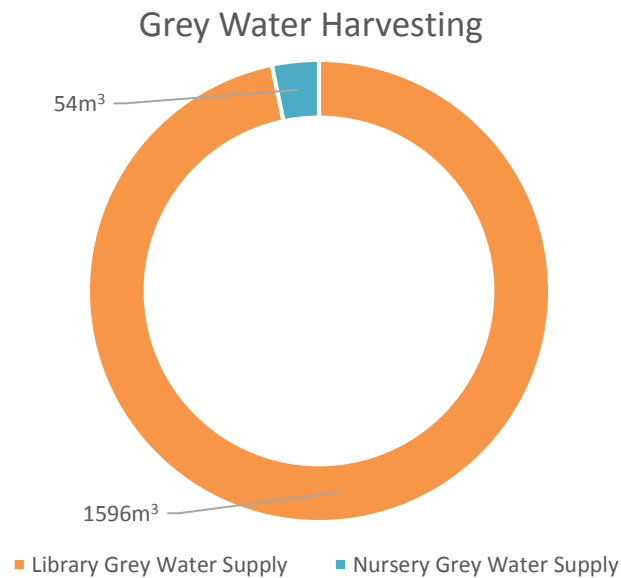
From April 2016 the Energy Manager produced a weekly Energy Awareness segment to be included in the weekly Estates Newsletter and as of July 2016, the segment is also included in the weekly StaffNet Newsletter. This segment contains advice about reducing water wastage for the workplace and home.

Overall saving from Staff Awareness/Good Housekeeping

As the awareness campaign started late on in the year and it included advice for the workplace and home, it is difficult to measure any savings.

Grey water/Rainwater harvesting

There is a rain water harvesting system in the SDR Library and the new Rocking Horse Nursery. Rain water contributed approximately 13% of the nursery's water needs and 30% of the library's needs.



Concluding Comments

This is a comprehensive analysis of the data available to the university. The Energy Management Team is in the process of overhauling the Monitoring and Targeting of energy use. As a result, issues have been identified with some past consumption figures and it is hoped that, as time goes on, we will get a stronger picture of where, when and how we consume energy. The new carbon management plan will be a catalyst for improvement in the energy efficiency of our estate and also strengthen our position for understanding and improving our performance.