

Annual Report on Energy and Environmental Management

Report by Energy and Environmental Manager – Martin Wiles

The Committee is asked to note that:

1. Energy saving investments made during the last year will save an estimated £113,000 per annum (See Section 3 for full details).
2. The University is on course to achieve its policy targets, carbon dioxide emissions per square metre have been reduced by 18% (against 20% by 2010), water consumption per square metre by 23% (against 20% by 2010) and waste reduction per FTE staff and student by 42% (against 60% by 2010).
3. Energy costs for the last year have risen by 39% due to UK commercial energy cost rises and continued electricity consumption growth. This growth in cost lead to a utility budget overspend of just under £1.1 million during 2005/06. The budget prediction for 2006/07 ranges from £7,698,095 to £7,058,093. The actual outturn will be dependent on a number of factors, particularly how cold the coming winter is.
4. Gas, steam, oil and water consumption have fallen year on year by 4% due to the installation of a range of energy and water saving technologies and practices. Electricity consumption has risen by 3.4%, higher than last years' 1% rise, but lower than previous years' rises of 5%.
5. To address the growth in utility consumption and cost, significant capital investments in energy saving projects is being made; £370,000 was invested in projects during 2005/06, with a further £300,000 to be invested during 2006/07. Two Combined Heat and Power units will be operating from October 2006, saving upwards of £280,000 a year. Energy prices are still predicted to rise over the next few years and continued investment is required year on year to reduce the impact of these rises.
6. The University has achieved an 8.5% reduction against its European Carbon Emissions Trading scheme target of 16.5% carbon reduction. Further reductions are predicted following installation of energy saving projects over the summer 2006 (344 tonnes) and new projects during 2006/07. To date (August 2006) the University is exceeding its target by 8% (894 tonnes), if this is the position at the end of the scheme, it could cost the University nearly £19,000 in penalties.

This document will be of interest to:

UPARC, staff within the University.

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None.

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The Energy and Environmental Management Unit.

University of Bristol

ESTATES COMMITTEE – 13 October 2006

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1.0 Energy and Water, Cost and Consumption for 2005/2006¹

EXPENDITURE AND CONSUMPTION FOR 2004/5 AND 2005/6 FOR ACADEMIC/ADMINISTRATION						
	2004/5 Cost	2005/6 Cost	Variance	2004/5 Consumption (kWh)	2005/6 Consumption (kwh)	VARIANCE*
Electricity	£1,906,301	£2,743,630	+43%	45,715,651 (19,658 tCO ₂)	47,294,851 (20,323 tCO ₂)	+3.4%
Gas	£1,102,767	£1,466,142	+33%	59,030,296 (11,216 tCO ₂)	56,897,284 (10,811 tCO ₂)	-3.5%
Steam	£87,309	£90,379	+3.5%	1,803,468 (343 tCO ₂)	1,511,097 (287 tCO ₂)	-16%
Fuel/Oil	£27,064	£30,962	+14%	862,407 (215 tCO ₂)	806,759 (202 tCO ₂)	-6.5%
TOTAL	£3,123,441	£4,331,113	+39%	108,249,038 (31,425 tCO ₂)	106,930,791 (31,623 tCO ₂)	-1.3% (+0.6%)
Water & Sewerage	£408,897	£414,708	+1.4%	295,006 m ³	269,656 m ³	-8.8%
Waste	£180,000	£208,136	+16%	938 tonnes**	1198 tonnes	+27%

* Estates growth between the two years has been less than 1%.

** These tonnages are based on limited available data.

1.1 Each energy type has been converted in the table above to show the emissions of carbon dioxide produced from the use of that fuel. Electricity consumption produces just over twice the amount of carbon dioxide (0.43 kg/kWh) that gas (0.19kg/kWh) or oil (0.25 kg/kWh) do per kilowatt-hour (kWh).

¹ Some figures for 2004/05 have changed slightly (<1%) since last year's report as more detailed information has become available in the interim.

Consumption, carbon dioxide emissions and water consumption are shown graphically in Figures 1-8.

1.2 Electricity costs and consumption.

Consumption has shown an increase of 3.4% and costs have increased by 43%.

Cost increases have been due to a 123% increase in prices with a new contract starting 1 April 06. This came in higher than the 60% increase originally budgeted for, due to worldwide market price increases.

In the early part of 2005/06, electricity consumption on the precinct was running 0-2% down on the previous year, but began to climb sharply from 23 November 2005 leading to the 3.4% growth. This is believed to be due to; the commissioning of H-floor (Medical School), which is very highly serviced and the start of the cold winter (illustrated by the snowstorm on 23 November). There is uncertainty about the contribution of electrical heating in this increase, with other potential contributions including the use of electrical heating to meet heating demand due to gas boiler problems at Barn 1 and an increase in student numbers by 0.8% which will create an upward pressure on consumption.² Staff numbers have increased to 5,549 at 31 July 2006, an increase of 2.3% on the year from 5,445 in 2004/05³.

The University continues to pursue energy and cost-saving projects, and we are beginning to see the fruits of these in, for example, reductions in consumption at Dorothy Hodgkin Building (DHB) after changes were made to the chiller plant, showing a 10% reduction. An investigation into whether VAT on electricity use can be re-negotiated is being carried out⁴, and has already yielded £66k in savings at DHB. We will also conduct an investigation into possible savings on pass-through charges later in the year.⁵

We will face significant additional spend later in the year as Lowtex (Low Temperature Experimental Laboratory), High Performance Computing and Nanoscience come on line. Predicted costs for these facilities have been incorporated into the Utilities Budget Model, developed in March 2006.

² Source: http://www.bris.ac.uk/ssio/studentdata/statistics/matrix/totalstunos_year_04_05.html

	01/02	02/03	03/04	04/05	05/06
Total student count	15,686	16,227	16,772	17,104	17,242
Year on year increase		3.4%	3.4%	2.0%	0.8%

³

Staff 31 st July 2005	Staff 31 st July 06
Appointments: 5549	Appointments: 5657
People: 5445	People: 5549
FTE: 4780.5088	FTE: 4890

⁴ By Jeff Kirkham, the University's Tax Manager, in collaboration with the Energy & Environmental Management Unit.

⁵ 'Pass through' charges are distribution and transmission use of system charges.

1.3 **Gas costs and consumption.**

Consumption has reduced by 3.5% over the last year, despite the coldest winter for 20 years (2,014 degree days in comparison to 1,848 in 2004/05). A variety of factors are likely to have contributed to this:

- We have achieved measurable improvements in control at a number of buildings, which now respond better to external temperatures.
- Due to close monitoring of temperatures, heating services were able to be switched off before Easter, and warm weather meant that it did not need to be turned on again, in most cases.
- We are conducting a process of rationalisation of hot water services, which is delivering savings on gas consumption during the summer.

A detailed analysis of consumption data has been facilitated by the population of a new energy database, and we now have a firm grasp of how gas consumption relates to external temperatures for budget tracking purposes.

Gas prices rose between 2004/05 and 2005/06 by almost 35% and this is reflected in the increased cost noted in the table in 1.0 above

Gas prices for the University are fixed until 1 August 2007. We are currently expecting increases of around 50% in gas prices on the new contract.

1.4 **Steam costs and consumption.**

The University uses steam at the Old Children's Hospital/ALSPAC. This steam is provided by UBHT from their gas boilers. Consumption has fallen mainly due to reduced operation of the site during 2005/6; cost has risen with increases in gas prices paid by UBHT and therefore passed through to the University.

1.5 **Oil costs and consumption.**

Consumption has fallen as a result of a migration from oil-burning systems to gas burning systems in order to realise cost and carbon savings. These will be seen in full in financial year 2006/07. Cost has risen as a direct result of higher worldwide oil prices.

1.6 **Water and sewerage costs and consumption.**

Consumption has fallen by 9%, after last year's 28% fall, due to further water conservation measures such as urinal controls. The replacement of once through water-cooling systems by closed circuit cooling has also had a significant impact. Costs for water and sewerage have risen by about 15%, but these have been mitigated by the reductions in consumption.

1.7 **Waste & Refuse.**

Costs have risen over the last year due to increased landfill costs and costs relating to dealing with hazardous waste. The tonnage figures for waste produced include all waste whether it goes to landfill or is recycled. The

increase in the tonnage is a function of improved data collection. Further work is required to include other tonnages from areas like 'skipped' materials, to further improve the ability to monitor waste disposal accurately. Overall recycling has increased to 53% of all waste produced within the University (by weight).

1.8 **Budget out turn 2005/06.**

The overall utilities expenditure during 2005/06 was £5,356,582 (including wages and sundries costs) against a budget of £4,303,725, an over spend of £1.05 million, as predicted in March 2006 and reported previously to the Estates Committee.

1.9 **Future Projections.**

The predicted out turn for 2006/07 has been modelled to give two range figures of £7,698,095 down to £7,058,093.

These two scenarios reflect potential variations in key influencing factors affecting utility use, e.g. weather. The principle differences between the two resulting forecasts are;

- The highest predicted out turn (£7,698,095) is based on a 20 year average coldest winter, oil and steam prices rise by 10%, gas and electricity consumption rise by 3%.
- The lowest predicted out turn (£7,058,093) is based on a 20 year average warmest winter, no gas and electricity growth beyond estates growth and oil and steam costs rise by 10% but consumption falls due to efficiency projects carried out and reduced required steam.

In both scenarios the inflation is cost of gas and electricity is zero. Other key factors affecting both scenarios equally are the operation of the CHP units (operating October 2006) and when the Nanoscience (operating April 2007), Lowtex (operating August 2006) and HPC (part load from October 2006, full load at 361kW by February 2007) projects come on line. At present the Met Office is forecasting a warm wet winter.

Predictions for 2007/08 are estimating a range from £7,487,896 up to £9,184,357, with the variance being a result of the difference between coldest to warmest winter and an overall increase in consumption across the board. 50% increase in gas prices is assumed, see above.

Energy markets are still volatile; prices during September have been falling, with current market prices being 2.4p/kWh for gas (existing contract 2.1p/kWh) and 8.0p/kWh for electricity (existing contract 9.1p/kWh). At the time of purchase of our 3-year contract for electricity in Jan 2006, predictions were that the prices would continue to increase through the year. The market

was very volatile at the time, changing by several percent a day, and trending upwards. Leaving the purchase any later could have led to higher prices.

However, over summer 2006, and thus since the beginning of our current contract, wholesale electricity prices have reduced as gas supply infrastructure projects have come on stream ahead of schedule, and prices have fallen.

The University is thus now exploring with its main electricity supplier, British Energy, the possibility of amending the current contract to access lower prices in the period 07/09 in exchange for a longer contract term, perhaps finishing in April 2011. EEMU is investigating the benefits, risks and legal implications attendant to such an arrangement and will report to the Bursar during October 2006.

1.10 Analysis of weather influence.

The weather is unpredictable and one winter may be much cooler than the next, with an related effect on the amount of heating fuel consumed by the University's buildings. The dependency between fuel consumption and temperature (recorded as degree days)⁶ in the University's buildings is now much better understood as regular analysis of buildings or groups of buildings is now possible with our energy management systems Stark, fully commissioned in Autumn 2005.

Using meteorological data⁷ it has been possible to estimate the likely range of warmest and coldest winters and to estimate from this the likely range of fuel consumption. It has been found that a variation of 2 standard deviations (SD) from the 10-year degree day average predicted the following year's degree day variance consistently for the past 15 years, and a single standard deviation was correct for only three years out of four. Because of this, a 10-year average +/- 2SD range is now used as input into the Utilities cost model.

1.11 Carbon Emissions Trading.

In January 2005 the University joined the European Carbon Emissions Trading scheme. This scheme is administered by The Environment Agency and the Department for Environment, Food and Rural Affairs (DEFRA) and sets binding targets for reducing carbon dioxide emissions over the next eight years. The scheme only applies to the University precinct and for gas and oil use. For the next three years the University has an emissions target of 6,529 tCO₂ each year, against a normal level of 7,811 tonnes per year. This represents a 16.5% reduction for emissions from the precinct.

⁶ Degree days are a measure of the number of days for which a mean temperature variance below 15.5°C occurs. This is the temperature above which a "typical" UK building will gain enough energy from the sun, occupants and electrical equipment within the building such that no additional heating is required. The colder the weather, the higher the degree day value and the more heating is required.

⁷ We have records going back several decades on the number of degree days experienced each month.

Since the 1st January 2005 we have emitted 11,823 tonnes of CO₂. Our emissions target for August 2006 is 10,929 tonnes. We are therefore currently exceeding our target by 894 tonnes which represents a difference of 8%. A number of carbon (and cost) saving projects have been installed over the last year (especially during the summer) which will save 344 tonnes of carbon a year. Further projects are to be installed during this coming year including reviewing the operation of the BEMS, replacement of old inefficient boilers and draught proofing, with the aim of achieving our target.

If the University were to remain 8% above our allocation we would need to purchase approximately 1,567 tonnes of CO₂ at the end of phase 1. Based on current market prices this would equate to £18,800.

1.12 Environmental Legislation.

Over the last year the EEMU has had to spend a significant amount of time dealing with compliance of environmental such as the EU ETS and Hazardous Waste Regulations. The EEMU has clarified its role in terms of addressing compliance, now identifying relevant legislation, evaluating its impact on the University, developing and ultimately implementing procedures to achieve compliance. Auditing of compliance with these procedures will fall to the University's Health and Safety Office. To assist the University in delivering these new procedures, an environmental management system is to be introduced during the next three years called EcoCampus.

1.13 Student Accommodation

EXPENDITURE AND CONSUMPTION FOR 2004/05 AND 2005/06 FOR THE HALLS AND STUDENT RESIDENCES OPERATED BY THE UNIVERSITY OF BRISTOL						
	2004/5 Cost (£)	2005/6 Cost (£)	VARIANCE	2004/5 Consumption (kWh)	2005/6 Consumption (kWh)	VARIANCE On kWh
Electricity	£385,441	£481,101	+25%	10,210,888 (4,391 tCO ₂)	9,465,396 (4,070 tCO ₂)	-7.3%
Gas	£256,737	£339,307	+32%	15,330,915 (3,134 tCO ₂)	15,577,343 (2,960 tCO ₂)	+1.6%
TOTAL	£642,178	£820,408	+28%	25,541,803 (7,304 tCO ₂)	25,042,739 (7,030 tCO ₂)	-1.9%
Water & Sewerage	£292,933	£280,575	-4%	170,740 m ³	145,992 m ³	-15%

Overall costs have risen in the halls and student residences, as a direct result of gas and electricity price increases. The closure of Richmond Terrace residences saved 426,000kWh of gas and 327,000kWh of electricity. Without this, the variance on

gas consumption would be +4.4% and on electricity consumption, -4.1%. Gas consumption has increased – this is probably due to the cold winter, but needs careful monitoring and stewardship.

2.0 Energy, Water and Waste Targets

2.1 In June 2004 the University Planning and Resources Committee agreed a new environmental policy with three key targets:

- a) To reduce carbon dioxide emissions per square metre by at least 20% below 2000/2001 levels by the 2010.
- b) To reduce water consumption per square metre by at least 20% below 2000/2001 levels by 2010.
- c) To reduce waste per FTE equivalent (staff & student) going to landfill by 60% below 1997/98 levels by 2010.

2.2 Progress to date is shown below and applies to all University run properties including academic, administrative and residential halls.⁸

	2000/1 Baseline	2003/4 Actual	2004/5 Actual	2005/6 Actual	VARIANCE (Baseline to 2005/6)
CO ₂ Emissions/m ² (in Tonnes)	0.130	0.110	0.110	0.106	-18%
Water Consumption/m ³	1.78	1.63	1.34	1.37	-23%
Waste to landfill kg per FTE (baseline 1997/98)	43.32	22.49	21	25.25	-42%

2.3 The table above shows that the University is on course to achieve its policy targets and has already achieved the water target.

2.4 The waste to landfill target figure has fallen from 51% to 42%, this is a reflection of improved data capture, including more streams of waste than previously (due to limited available data). Overall recycling rates have improved, which is one of the key ways of diverting waste from landfill, rising from 350 tonnes to 633 tonnes over the last two years. During 2006/07, the recommendations from a recycling review; a new procurement policy (to help reduce waste packaging) and a number of reduction initiatives will be implemented, all with the aim of reducing waste and achieving the University's environmental targets.

1.13 Estate Management Statistics.

As the University progresses with implementing its environmental policy, benchmarking of its performance is becoming important. The Estates Management Statistics provide a broad approach to benchmarking, looking at

⁸ 2005/06 Floor areas for all 382,254 m² gross and 277,911m² useable. "Gross" figure used for 2005/06 with totals of 524,625m³ of water consumed and 40,683 total tonnes of CO₂ produced.

energy and water cost and consumption between different HE institutions. Whilst this offers a good starting point, it does not account for regional, operational, building age and even size variations that will have a significant impact when comparing HE institutions.

The EEMU has developed a utility metering strategy which is being implemented over the next three years, which will enable a much more detailed analysis of individual types of building within the University. At the same time the University will be working with other similar institutions (Russell Group) to identify like for like buildings to establish more relevant benchmarks. In this way the University will have a better understanding of its performance in relation to relevant standards

3.0 Progress with Energy & Environmental Management during 2005/2006

3.1 Energy and Water Management:

- Energy saving investment projects totaling £377,000 including; controls on heating, lighting, ventilation, chilling and urinals; insulation and heating and lighting upgrades generating estimated savings of £113,000. An example of a measured saving is shown in Figure 9. Here, intervention at DHB included system reprogramming to ensure provision of ventilation more accurately followed occupancy and liquid pressure amplification on the chiller reduced consumption. Some 70,000kWh have been saved in the period May-Aug 2006, with avoided costs of over £6,000.
- Implementation of a cooling strategy relating to air conditioning, ensuring the most appropriate and energy efficient systems are provided. Cooling within the University represents a significant load of up to 2MW in the summer.
- Combined Heat and Power (CHP) Units have been installed in the Medical school and Chemistry; starting operation in September 2006. They are estimated to save £280,000 per annum.
- A further CHP unit is to be installed at Langford over the next year.
- Energy Partnership with the Carbon Trust bringing in £20,000 in funding for help to identify major energy saving projects, this year includes work on refrigeration, efficient operation of the BEMS (heating and ventilation) and a scoping study for renewable energy.
- A comprehensive review of utility budget models, developing a standard model updated each month for both current and next year review. Two further years are being developed to feed into the three year budget forecasting.
- The new energy management database (Stark), run by the Utility Systems Manager and part-time Invoice Clerk, checks every line of every energy invoice received. This ensures better budget management, prevents over payment and highlights over-consumption very early so that remedial action can be taken. It is far more flexible than the previous TEAM system. Historical bills have been queried and we estimate that

up to £50k was saved in 2005/06 by this. It is also enabling us to manage complex renegotiations of VAT and electricity pass-through charges which has already yielded a refund of £43k in 2006/07; more is expected.

3.2 Legislative Compliance:

- Work continues on implementing procedures relating to the Hazardous Waste Regulations, which has reclassified over 200 materials as hazardous waste including a range of chemicals used in laboratories, computer monitors, fluorescent tubes, fridges and certain paints.
- To comply with the legislation a paper audit trail has been put in place to enable the transfer of hazardous waste between sites and within sites.
- A University wide collection system is being introduced for the collection and storage of hazardous waste.
- Departmental waste audits have been carried out in Medical school and the Pre-Clinical Vet School.
- A watching brief is being maintained to ensure that the University can implement the new WEEE (Waste Electrical and Electronic Equipment) and buildings energy directives once the guidelines have been released.
- The new part L building regulations were introduced in April. The EEMU has been proactive in reviewing their implementation in relation to new projects.

3.3 Recycling & Refuse:

- Recycling rates across the University have increased to 53%.

3.4 Environmental Awareness and Education:

- Assisting with the development and delivery of an open unit in Sustainable Development.
- A range of events for the PWE week in September.
- A presence at University induction sessions for all new staff.
- Induction talks at halls of residences aimed at all new students.
- Information stands at the Estates Supervisory seminar and Students' Freshers' fair.
- Specific talks to residential hall staff and to the academic registry on how they can reduce their energy use.
- Promotion of the green office charter, 3 departments have signed up.
- Regular e-news updates to the environmental forum.
- An awareness raising campaign within residences involving regular 'mail-outs' of posters as well as 'in-person' briefings.
- A similar poster campaign aimed at staff was run during the year.
- Two articles relating to the work of the EEMU aimed at raising awareness have been included in University News.

3.5 Built Environment:

- BREEAM (Building Research Establishment Environmental Assessment Method) is to be used as a deliverable for all new build and refurbishment projects, with focus on revenue reducing outcomes.
- BREEAM is built into the new consultants framework agreement, project office procedures and outcome specification.
- A new procedure for inclusion of energy-saving features within smaller building projects is being implemented within Building Services.

3.6 Sustainable Procurement

- A draft sustainable procurement policy for University approval has been drawn up.
- Involvement with a national project within the HE sector to develop more sustainable procurement approaches.

3.7 Presenting the University to the Community:

- The Energy and Environmental Management Unit (EEMU) continue to be involved in a number of local and national initiatives. These include being committee members of the Environmental Association for Universities and Colleges (EAUC), members of the Council run Green Commuter Club, Bike Forum and Sustainable Development Action Group.

Fig 1: Cost of Consumption of different Utilities, Academic & Administration

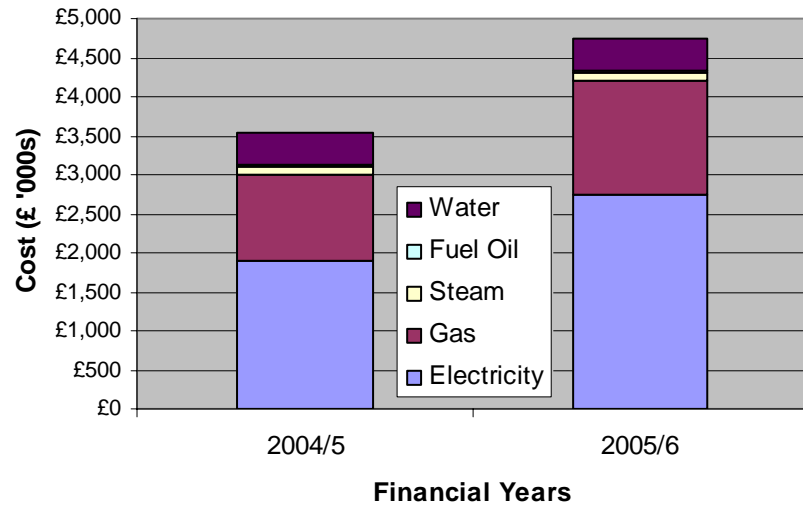


Fig 2: Fuel Consumption ('000s kWh) Academic & Administration

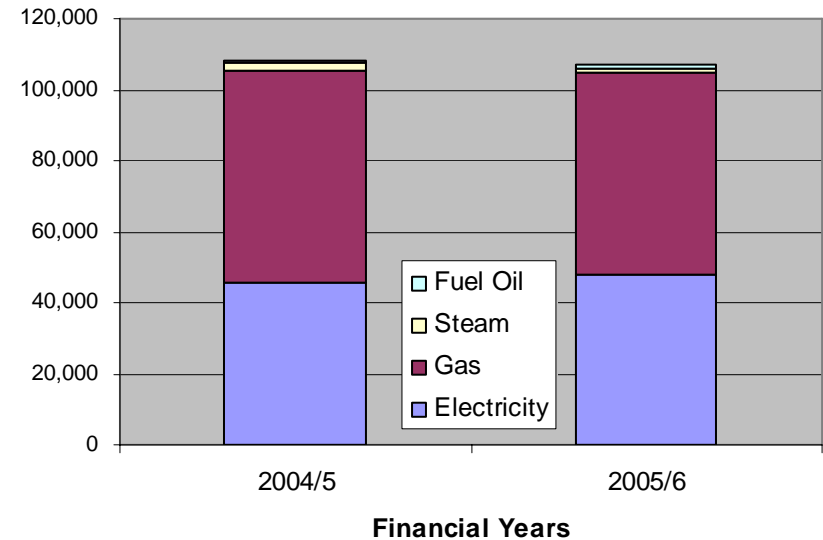


Fig 3: CO2 emissions from fuel consumption (tCO2) Academic & Administration

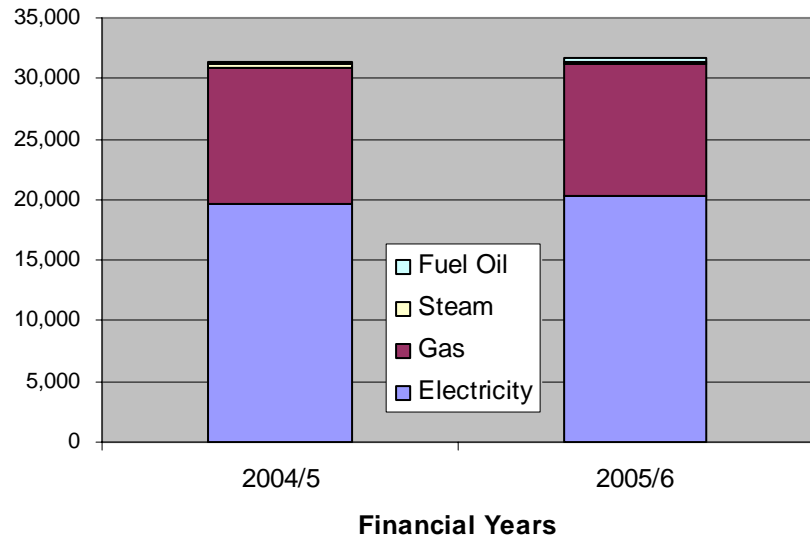


Fig 4: Water Consumption (m3) Academic & Administration

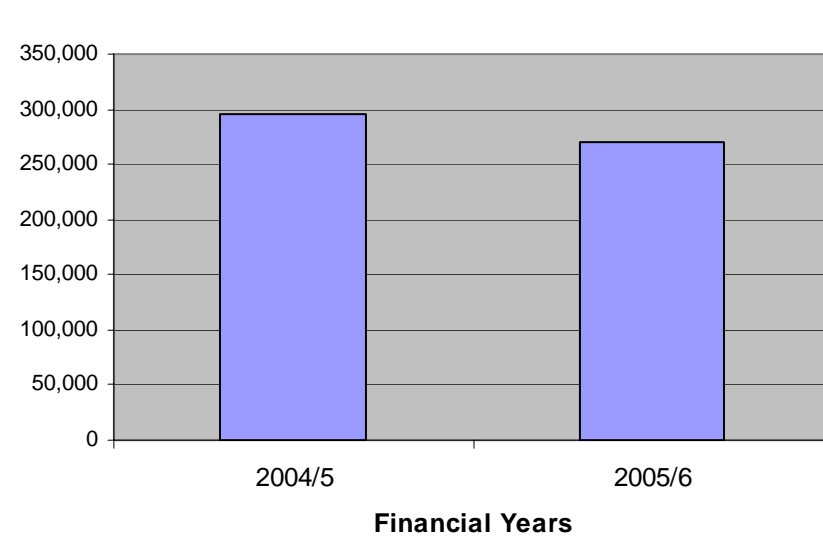


Fig 5: Cost of Utilities Consumption in Residences (£ '000s)

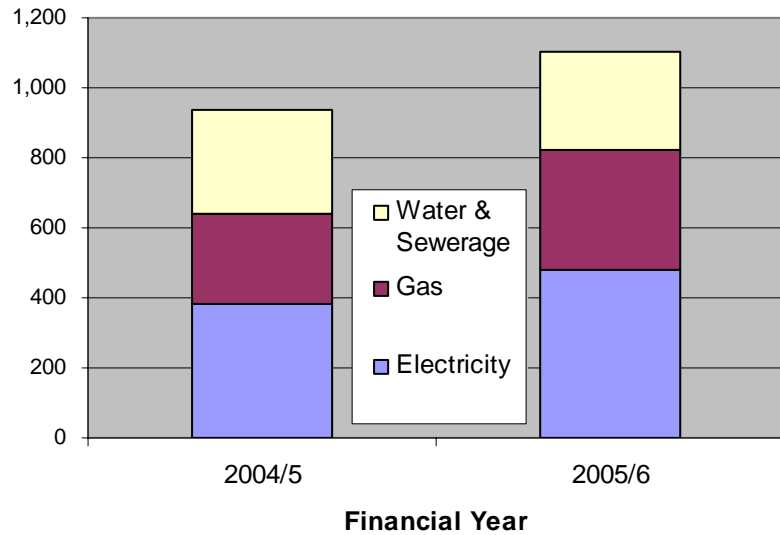


Fig 6: Fuel Consumption in Residences ('000s kWh)

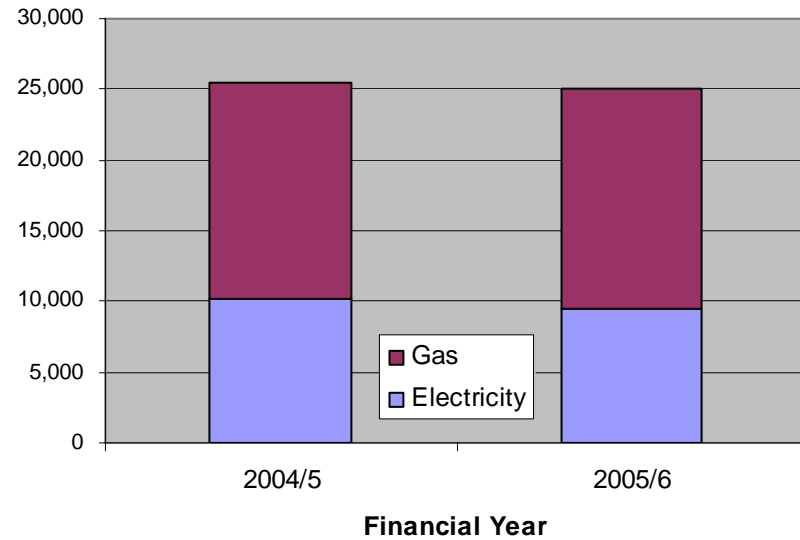


Fig 7: CO2 emissions from fuel consumption in Residences (tonnes)

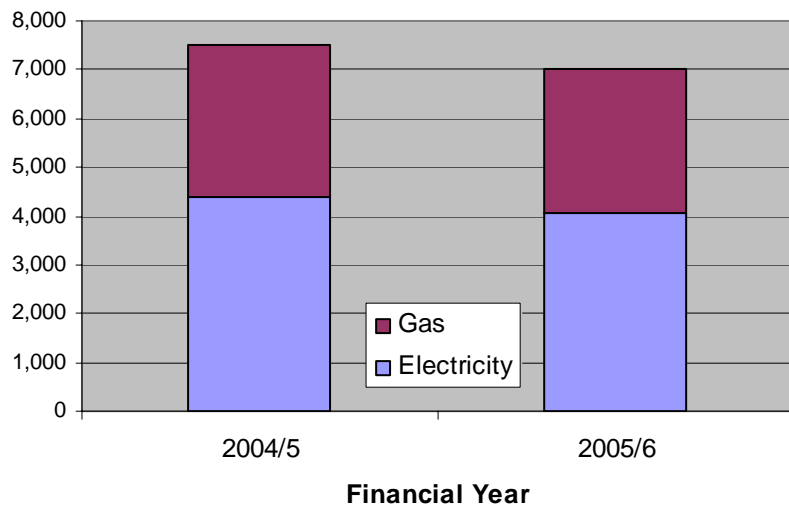


Fig 8: Water Consumption in Residences (m3)

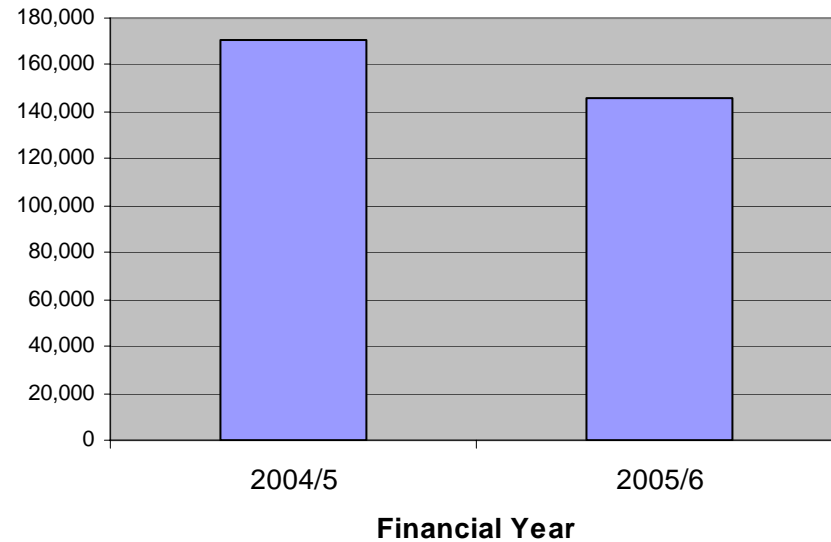


Fig 9: Dorothy Hodgkin Building: Effect of Energy Efficiency Measures in Reducing Electricity Consumption

