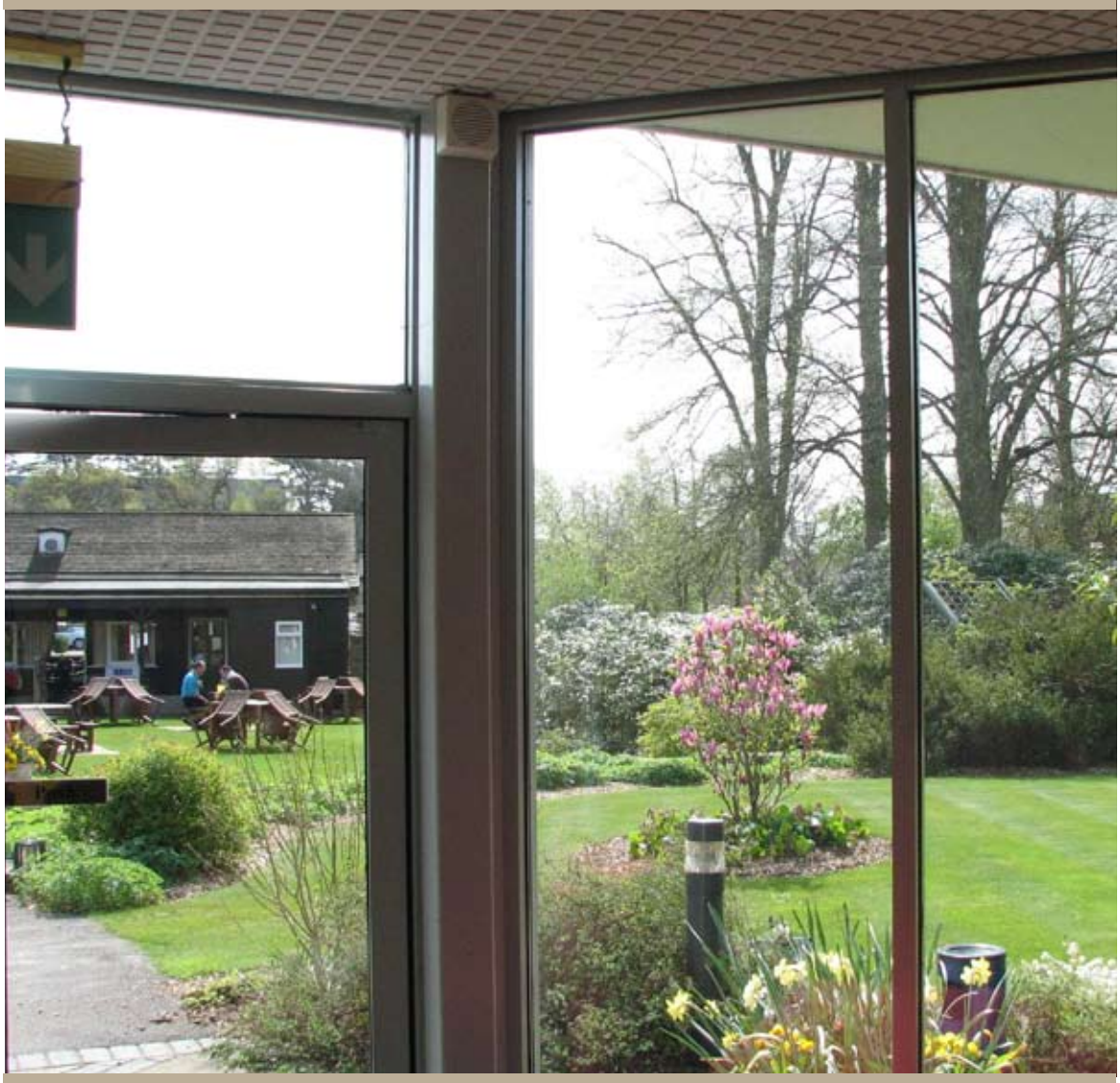
CARBON FOOTPRINTING AND ENERGY EFFICIENCY AUDIT

Woodhall Spa Golf Club



Produced on Behalf of The R&A, EGU and GUW

JANUARY 2010

By

Kelly Harmar & Richard Stuttard

Ecology & Environment

STRI

St Ives Estate, Bingley, West Yorkshire, BD16 1AU

T: 01274 518903 ● F: 01274 561891 ● E: info@stri.co.uk ● W: www.stri.co.uk

STRI Ecological & Environmental Services

1.0 INTRODUCTION

The STRI Ecology and Environment Unit have been commissioned by The R&A, The English Golf Union and The Golf Union of Wales to undertake a carbon footprinting and energy efficiency audit of three golf clubs in England and Wales: Alresford Golf Club in Hampshire; Conwy (Caernarvanshire) Golf Club in North Wales and Woodhall Spa Golf Club in Lincolnshire.

These three clubs were chosen to represent elements of Heathland, Parkland, Downland and Links golf courses, with buildings built between 1905 and 1998, to ensure that a wide range of golf club set ups were covered. The clubs are also at different stages in their energy management.

The energy efficiency and waste management advice given during the project should help the clubs to save energy, reduce waste and greatly reduce their overheads. In doing so, the carbon emissions from the clubs should also decrease, reducing their contribution to climate change. The reports are available for other golf clubs to look at on The R&A, EGU and GUW websites, alongside a 'Carbon Calculator' which will allow clubs to enter simple utility and energy data and gain an estimate of their own carbon footprint.

2.0 WOODHALL SPA GOLF CLUB

Woodhall Spa Golf Club was established in 1905. The National Golf Centre at Woodhall Spa consists of two 18 hole golf courses (the Hotchkin Course and the Bracken Course). The Club supports a 600 strong membership and the estimated annual footfall at the club is in excess of 75000. The original wood construction clubhouse dating back to 1905 is still present and in use to this day and given its age and type of construction, does not have the benefit of modern day insulation. In 1995 a Conference Centre was constructed at the Woodhall Spa site and in 1998 the original clubhouse was extended considerably, incorporating additional changing facilities and meeting rooms. These recent constructions at Woodhall Spa do have the benefit of effective roof, window and cavity wall insulation. Roof insulation within the newer buildings was found to be 200-300mm in depth.

Mains water is fed to the clubhouse and the central heating systems are fuelled by natural gas.

Glass, paper and food waste is all recycled by an external contractor with some waste also being composted.

The principal maintenance buildings were constructed in 1998. The water supply for the maintenance buildings is from the mains whilst irrigation water for the golf course is sourced from two on-course reservoirs. Some golf course waste is composted and re-used on the golf course. In addition to the wide range of diesel, petrol and electric golf course maintenance vehicles (see Appendix 1), the club also owns a petrol fuelled Ford Escort.

The club own two electric and one petrol fuelled golf buggy and also hire two further buggies for use on the course. Golf buggies are, in the main, used exclusively by staff.

3.0 METHODOLOGY

There are two elements to the carbon and energy audit: i) a high level carbon audit which allowed considerations of all energy use and waste produced by the golf club and ii) a more detailed assessment of equipment and energy use across each area of the clubhouse and golf course management.

3.1 CARBON FOOTPRINTING

The carbon footprint of the golf clubs estimates the total set of greenhouse gas emissions caused directly and indirectly by the golf club in one year. These emissions come from electricity use, central heating, fuel for course maintenance equipment and the treatment of waste and wastewater.

3.1.1 Scope of the carbon footprint

An important stage at the start of any audit is to determine the scope of the project, i.e. what data are ideally required and what can be achieved given time, cost and quality constraints. A golf club is a complex business with multiple energy sources and operations occurring across the golf course and within the various elements of the clubhouse.

The golf club audits follow the recognised methodology set out in *The Greenhouse Gas Protocol*, produced by the World Business Council for Sustainable Development and the World Resources Institute, which uses 'control' (either financial or operational control over operations) as a means of defining a boundary for the scope of an audit. This assumes that the aim of the audit is to reduce emissions where the golf club has direct control and not to undertake a complete life cycle assessment (LCA) of all the operations relating to the golf club. Under this remit, the audit will consider lighting, heating, general energy use and waste produced from the following areas of the golf club operations: bar/restaurant, offices, changing rooms, toilets/showers, the pro shop, the maintenance compound, and maintenance of the golf course. However, operations and travel outside of the golf clubs direct control but necessary for the golf club to function (e.g. the extraction of raw materials, the production of machinery, processing of foodstuffs, chemicals, sand, etc. and travel undertaken by delivery vehicles and staff and member travel) will be excluded from the audit. The audit will not consider the carbon sequestration potential of the golf course land.

3.1.2 Data collection

Data for the carbon footprint was obtained from several sources:

1. Observations and quantitative measurements by STRI during visits to the golf clubs in April 2009.
2. Questionnaires responses from selected golf club staff.
3. Utility bills and fuel receipts held by the golf clubs
4. Published 'conversion factors' used to estimate the CO_2e emissions arising from energy use, water use and waste disposal

3.1.3 Carbon conversion

The energy used and waste produced by each golf club was converted to metric tonnes of carbon dioxide (t CO_2e) using *The 2009 Guidelines to Defra/DECC's GHG Conversion Factors for Company Reporting* (Defra and DECC, 2009). Metric tonnes of carbon dioxide were used as a cross-disciplinary unit, which allows direct comparisons between different operations and allows different operations to be aggregated to provide an overall footprint for the selected operations.

3.2 ENERGY ASSESSMENTS

An energy assessment of each individual area of the club's operations, across the clubhouse and greenkeeping facilities was made during the site visit. This involved measuring the energy used by electrical appliances and lighting, checking the fabric of each building and observing operational practices.

Within each area, the energy consumption of each piece of electrical equipment was considered in terms of the likely electricity use and monetary cost across one year. Usage times for equipment in each area was calculated based on the assumptions described in Table 1. The annual cost of running each item of equipment was calculated by multiplying the annual kWh energy consumption by an average electricity cost for electricity in 2008 of £0.083 (based on the electricity rate from electricity bills in December 2008).

Table 1 Assumptions used to estimate usage times for equipment in each area of the club's operations.

Description of annual usage	Assumed hours
Equipment in constant use, e.g. fridges and freezers	24 hours per day, 365.25 days a year = 8766 hours per year
Equipment within main frequently used clubhouse areas (e.g. bar, lounge, locker rooms, hallways, etc.) and in constant use during opening hours	15 hours per day, 365.25 days a year = 5479 hours per year
Equipment within kitchen areas and in constant use during staff hours	10 hours per day, 365.25 days a year = 3653 hours per year
Equipment within the secretary's office and in constant use during staff working hours	8 hours per day, 260 days a year = 2080 hours per year
Equipment within greenkeeping areas and the pro shop and in constant use during staff working hours	8 hours per day, 365.25 days per year = 2922 hours per year
Equipment not in constant use	Estimated on an individual basis, e.g. electric showers assumed 3 hours per day, 365.25 days a year = 1096 hours per year

4.0 THE CLUB'S CARBON FOOTPRINT

The carbon emissions produced by Woodhall Spa Golf Club in 2008 totalled 326.2 metric tonnes of CO_2e[1]. This roughly equates to the CO_2 emissions generated by 60 company cars over one year, to the methane emissions generated by 107 cows over one year or the average CO_2 emissions generated in 20 minutes and 30 seconds by a conventional coal-fired power station[2].

[1] Expressing greenhouse gas emissions as CO_2e or 'carbon dioxide equivalent' allows greenhouse gases other than carbon dioxide to be considered, e.g. methane and nitrous oxide. Each of the various greenhouse gases have a different Global Warming Potential (GWP) per kg (a measure of their effect on global warming) and for comparison purposes the quantity of these gases released during a process are generally expressed as their carbon equivalent. For example, 1 kg of methane gas has the same global warming impact as 21 kg of carbon dioxide.

[2] Data on equivalent emissions was obtained from UNEP (2008) and Carbon Footprint (2009).

Table 2 below provides a breakdown of the elements contributing to this figure. The negative value within the commercial clubhouse waste column is a result of Woodhall Spa's current recycling initiatives. These recycling initiatives have resulted in 12.8 tonnes of carbon dioxide emissions from other sources at the club being offset.

Table 2 Carbon footprint of Woodhall Spa Golf Club for 2008 (based on the methodology described in section 3.1)

Element	Quantity 2008	Conversion Factor	kg CO_2e	% Contribution
Gas (kWh)	469377.2	0.2042	86168.3	26.4
Electricity (kWh)	273415.2	0.54418	148787.1	45.6
Petrol (litres)	5503.2	2.3307	12826.3	3.9
Diesel (litres)	19701.0	3.0289	59672.4	18.3
Mains water supply (m^3)	2237.4	0.276	617.5	0.2
Waste water treatment (m^3)	2013.7	0.693	1395.5	0.4
General waste (tonnes)	97.0	305	29597.2	9.1
Card/paper recycling (tonnes)	18.0	-713	-12834.0	-3.9
Total			**326230.3**	

Total carbon footprint 2008 = 326.2 tonnes

The figures in Table 2 represent Woodhall Spa's overall carbon dioxide emissions as determined from the club's utility bills for 2008. The next stage of the carbon audit is to provide an area by area evaluation of the clubhouse, pro shop and maintenance facility to identify the main contributors to Woodhall Spa's figure of 326.2 tonnes of carbon dioxide produced per year.

5.0 THE CLUBHOUSE – ROOM BY ROOM OBSERVATIONS AND RECOMMENDATIONS

Naturally, the clubhouse is a major contributor to Woodhall Spa's carbon footprint. As this building is the sole area for administration, member socialising and formal events, the demands on resources are inevitably wide ranging and frequent.

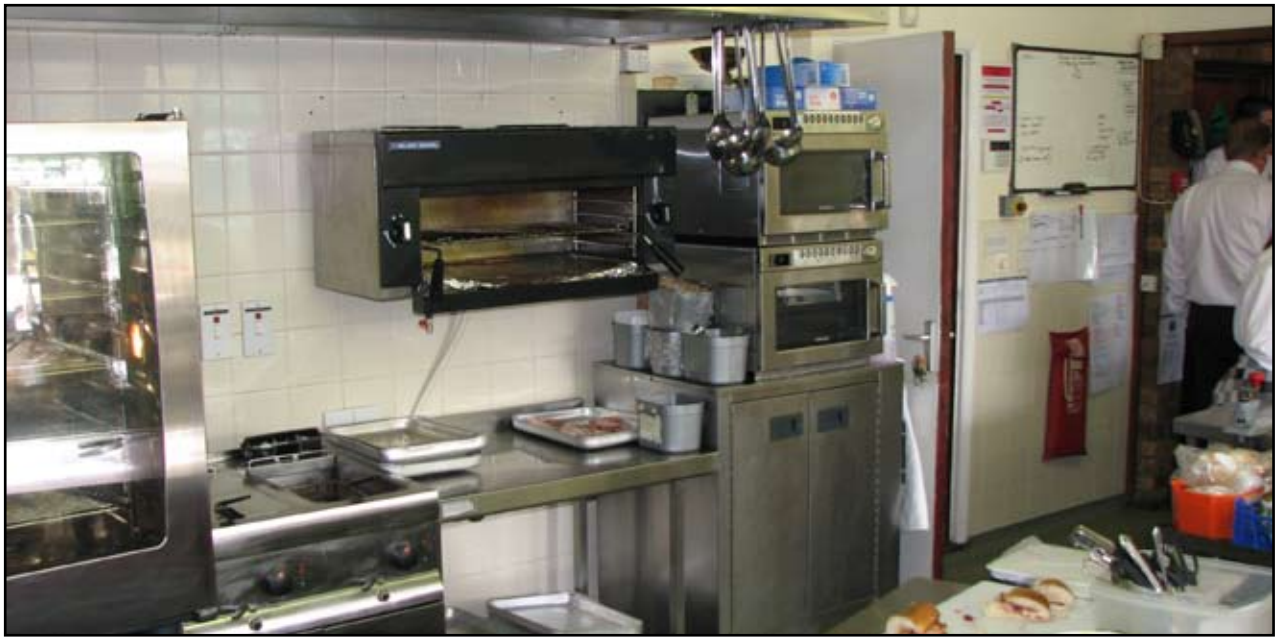
For the purposes of this study, the clubhouse at Woodhall Spa has been divided into the following sections:

Kitchen
Bar plus beer cellar
Dining area 1
Dining area 2
Offices
Changing rooms
Meeting room

The following text comments on energy-demanding equipment within these areas, along with recommendations for their use or replacement. Day-to-day operational practices are also reviewed with recommendations made on how these can become more efficient.

5.1 KITCHEN

The kitchen is home to a wide variety of energy-demanding appliances. In addition to these, there are a number of other items of equipment that, although demand a lower amount of energy, are using a constant supply of electricity. For instance, the clubhouse kitchen is supporting a total of four fridges and five freezers.



A list of all equipment can be found in Table 1 of Appendix 2.

It is, of course, essential that appliances such as fridges and freezers are left on 24 hours a day and whilst there can be no compromise with operating times, it should be recognised that new versions of these appliances will be considerably more energy efficient than those aged five years or more. This comment applies to all equipment within the kitchens at Woodhall Spa and is perhaps most applicable to the club's washing machine that appeared to be in excess of 20 years old.

The kitchen at Woodhall Spa Golf Club leads to a network of side offices. During STRI's visit to the club the general observations made in this area were that lights were left on in many of the storerooms and side offices when vacant and of particular note was the radiator in the staff locker room (a room which is only briefly utilised each day) which was constantly delivering heat and maintaining the room at an uncomfortable temperature. In addition to this, the food storage room adjacent to the staff locker room was being air conditioned and kept at a very low temperature. Only an ill-fitting wooden door separated the two rooms and, as such, the radiator in the staff locker room and the air conditioning unit in the food storage room were competing with each other and therefore demanding more energy.

Radiators were also found to be left on in a number of the offices to the back of the kitchen area and it was also noted that a number of spider burners were left running throughout the day rather than being turned off and relit when required.

The following table summarises the findings and potential solutions for issues arising in the kitchen and associated areas:

Issue	Solution
Lights on when room unoccupied	Motion sensor / signage / introduce "light monitor" personnel.
Equipment left on or on-standby when not in use	Turn equipment off when not in use. Employ "switch me off" stickers as reminders
Some appliances are dated and consume large amounts of power	Replace ageing appliances with new energy efficient models.
Heating on when rooms unoccupied and during periods of hot weather	Regularly monitor and adjust heating settings to meet the minimum needs required. Give someone the responsibility of heating monitor.
Food storage room air conditioned yet adjacent to over - heated locker room.	Fit better insulated door between the two rooms and turn heating and air conditioning down to minimum required levels

5.2 BAR AND BEER CELLAR

Table 2 (Appendix 2) lists equipment within the bar and beer cellar and offers selected information on their cost to the club.

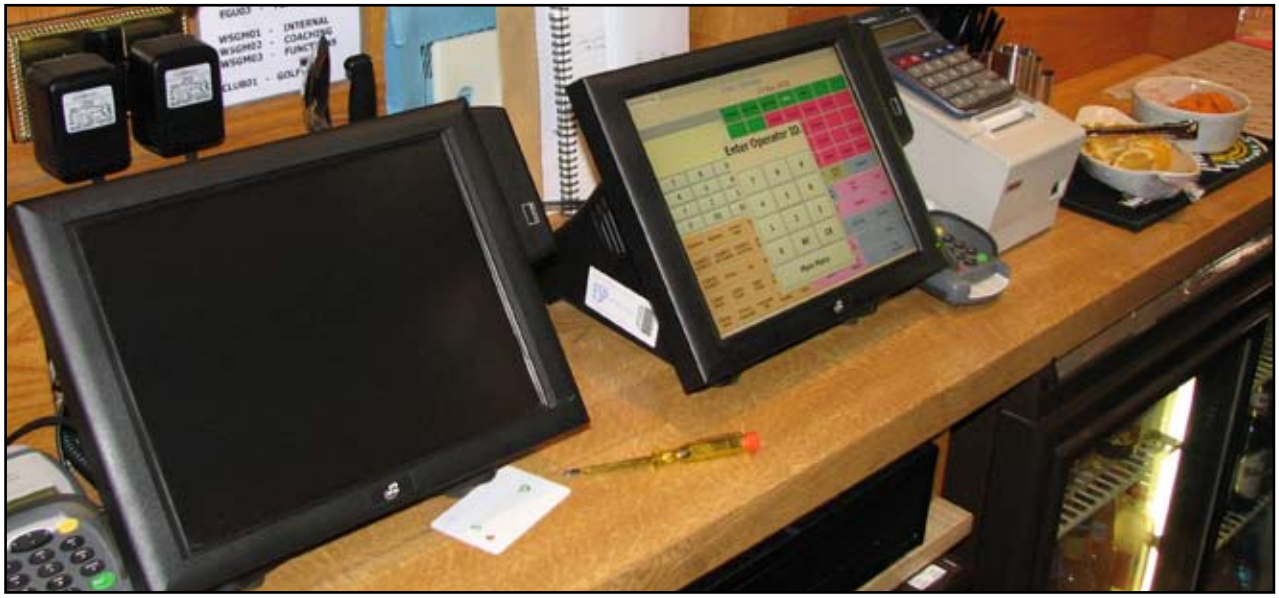
General observations made on the bar and beer cellar during STRI's visit were that lights were generally found to be switched off when the area was not in use. Lighting systems had differential controls for flexible use, however no motion sensors were fitted. Doors and skylight windows were found to be well fitted and insulated. Skylights will need to be cleaned regularly to retain natural light input.

There are a total of four fridges within the bar and beer cellar area plus a main beer cooler unit which requires a constant 418.3 watts of electricity. It is presumed the bottle fridges are left on overnight. There is potential to fit timers to the fridges which will allow them to be off during the night (between perhaps 12am and 7am) yet back on early enough to ensure drinks are cold in time for bar opening. It is estimated that this would result in a saving of approximately £40 per year.

The glass washer within the bar area demands the largest amount of electricity in this area at 2.85 kW, however this appliance is only intermittently used.

In addition to natural light from the skylights, the bar area is lit by 14 halogen spot lights estimated to be costing the club £270 per year. Replacing these with low energy LED bulbs would reduce this figure ten-fold.

All electrical equipment that is only required during opening hours, including tills, Sky box, card reader and receipt printers should be switched off at the mains when not in use. To highlight the cost of such appliances, the two tills, if left switch on 24 hours a day, cost the club the not inconsiderable sum of £367.14 per year.



Issue	Solution
Equipment left on or on-standby when not in use	Turn equipment off when not in use. Employ "switch me off" stickers as reminders
Natural light sources could function more efficiently	Clean skylights regularly
Halogen spotlights currently fitted	Fit energy efficient bulbs
Bottle fridges left on 24 hours a day	Fit timers to ensure fridges are only on when required.

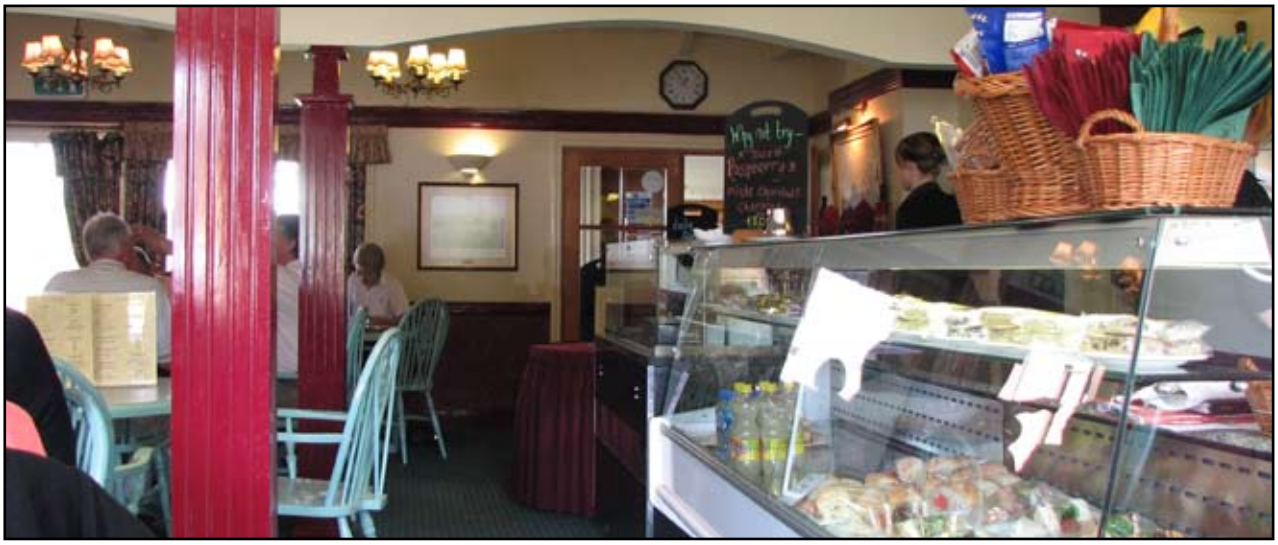
5.3 DINING AREA 1 (CLOSEST TO KITCHEN)

This dining area is within part of the original 1905 Clubhouse and therefore inevitably brings with it a certain degree of inefficiency. All windows are single glazed and there is no insulation within the roof cavity.

Table 3 (Appendix 2) lists all equipment within Dining Area 1. This dining area sees frequent use during lunchtime hours however is often empty at other times. Lights were noted to be left on at all times during hours of business. This practice could be changed by introducing "switch lights off" signage or fitting motion sensors. It was also noted that plenty of natural light was available as the room supports a total of five good sized windows to both sides of the building. As such it may be the case that artificial light is not required at all during daylight hours in summer. At the very least fewer lights should be used during these periods – an option already available to the club thanks the flexible lighting controls in this room. The club have already installed a number of energy efficient compact fluorescent bulbs in the dining room. The next step will be to replace all remaining incandescent bulbs. Lighting in dining area 1 is currently estimated to be costing the club £725 per year. It is thought that there is considerable potential to reduce this figure.

Installing double glazing and roof insulation would significantly improve the heat retaining properties of the dining area, however it is appreciated that it is crucial to retain the character of Woodhall Spa's historic original clubhouse.

A number of high energy appliances are used in the dining area including the "hot cupboard" which demands 2.2kW of electricity to function, a hot water boiler and display chiller. These appliances should only be on when necessary. The hot cupboard should only be required during peak meal times.



Issue	Solution
Lights on when room unoccupied	Motion sensor / signage / introduce "light monitor" personnel.
Equipment left on or on-standby when not in use	Turn equipment off when not in use. Employ "switch me off" stickers as reminders
Poor insulation	Investigate improving window, door and roof insulation.
Some inefficient light bulbs remain	Replace all incandescent bulbs with energy efficient varieties
All lights on during day despite good natural lighting	Fit light level sensors and utilise flexible lighting

5.4 DINING AREA 2

Table 4 (Appendix 2) lists all equipment in Dining Area 2 and indicates its annual cost to the club. The extensive second dining / lounge area, as with the first, is fitted entirely with single glazed windows and no roof insulation. This area was found to be largely unoccupied during a typical weekday, yet all lights were left on throughout business hours. The room is of a considerable size and as such both lighting and heating demands are high, indeed, lighting in this area is thought to be costing the club £1477 per year. Lights do have differential controls and so could be utilised in an "as required" manner. There are some 85 light bulbs within the dining area. These should all be of an energy efficient variety. It was also noted that the outside light in this area was on throughout the day. Giving personnel the responsibility of monitoring light usage would help prevent this problem.

Some removable partitions are in place in this room yet were not in use during our visit. Further partitions could be installed given the size of the room thereby allowing much of the room to be "closed" and therefore not lit or heated except when required for large scale functions.

Some of the current ceiling area is particularly high and therefore the installation of a false ceiling would also reduce heating costs.

There a 4 skylight wells in the ceiling which had become clogged with algae etc and would become much more effective if cleaned.

Finally a gas fire fitted within the dining room should rarely be required if the central heating system is being used correctly.

Issue	Solution
Lights on when room unoccupied	Motion sensor / signage / introduce "light monitor" personnel.
Equipment left on or on-standby when not in use	Turn equipment off when not in use. Employ "switch me off" stickers as reminders
Poor insulation	Investigate improving window, door and roof insulation.
Some inefficient light bulbs remain	Replace all incandescent bulbs with energy efficient varieties
All lights on during day despite good natural lighting	Fit light level sensors and utilise flexible lighting
Partitions in place but not fully utilised	Always have partitions in place if full room capacity is not required. Heating should then only be on in sections of room in use.
Sections of ceiling very high = requires considerable amount of energy to heat	Consider fitting false ceiling in these areas to reduce heating bills.
Natural light sources could function more efficiently	Clean skylights regularly

5.5 SECRETARY'S OFFICE/ADMIN OFFICE

Table 5 (Appendix 2) lists all equipment in the Secretary's/Admin offices. The two offices within the 1905 clubhouse, because they are areas not accessed by club members etc, were found to be exhibiting more efficient practices. Lights were turned off when vacant and heating was not on unnecessarily. The offices are also fitted with double glazing, significantly improving their heat retaining properties. Doors however, were not well insulated and it was believed that roof insulation was not present.

The offices support a considerable amount of electrical equipment including PC's, printers, scanners and a mainframe server. Other than the server, it is felt that all other appliances should be switched off overnight, and when not required during the day. Simply switching computers off during lunch hours would save approximately £9.55 per year.

The halogen spotlights and strip lights currently installed should be replaced with more efficient varieties.

Issue	Solution
Door and roof insulation poor	Investigate ways of improving insulation
Large amount of electrical equipment, some left on/on standby when not required	Ensure appliances are switched off at the mains at night, and when not required during the day
Lighting inefficient	Replace bulbs with energy efficient varieties

5.6 SMALL OFFICE (SEPARATE FROM SECRETARY'S OFFICE)

Table 6 (Appendix 2) lists all equipment in the small office. The small office, also part of the 1905 building, is poorly insulated (single glazed windows, wooden door and no roof insulation) and as such will require excess energy during the winter months. Office equipment was noted as being left on standby when not in use.

Issue	Solution
Window, door and roof insulation poor	Investigate ways of improving insulation
Large amount of electrical equipment, some left on/on standby when not required	Ensure appliances are switched off at the mains at night, and when not required during the day
Lighting inefficient	Replace bulbs with energy efficient varieties

5.7 LOCKER ROOMS (1905 BUILDING)

Table 7 (Appendix 2) lists electrical equipment in all locker rooms at Woodhall Spa. The locker rooms within the 1905 building are for members only. There are a number of issues with these areas and locker rooms are without doubt one of the prime targets for installing energy saving measures.

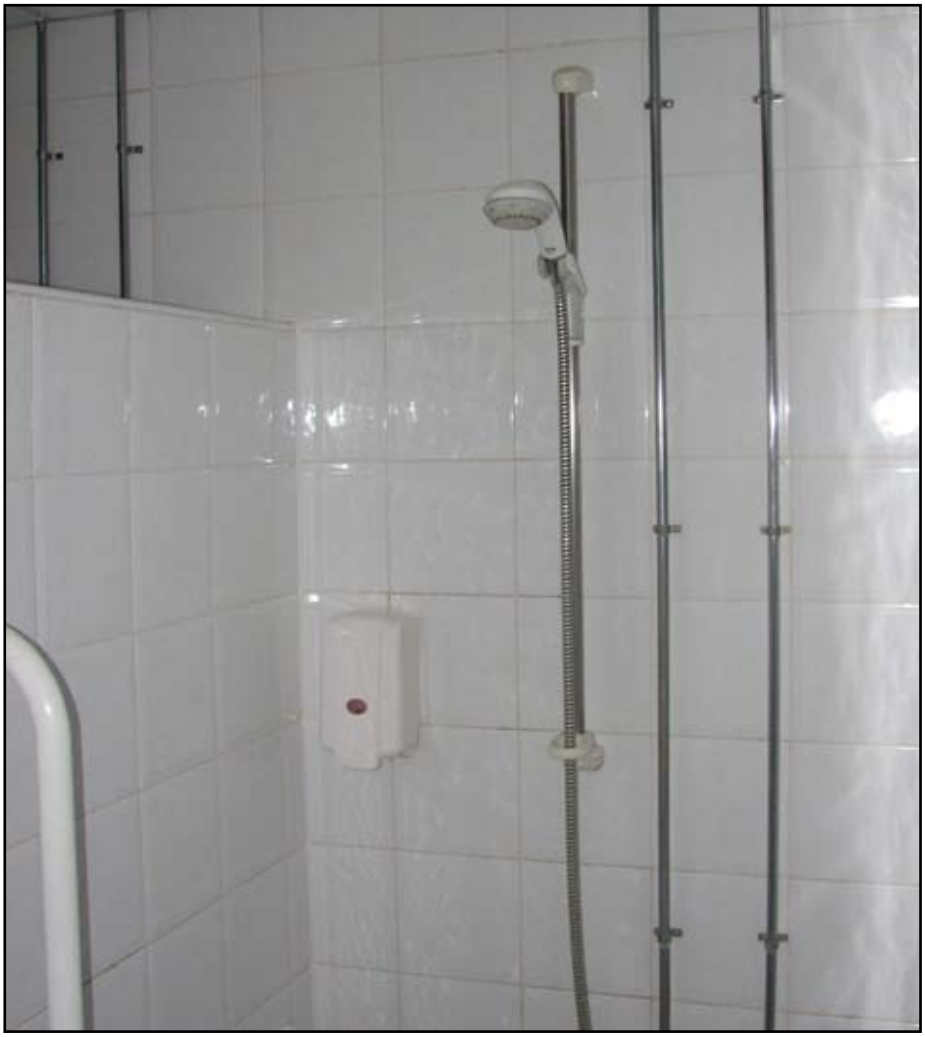
Being the 1905 building, all windows are single glazed and will open, therefore the potential for heat loss is considerable. Lights in the locker rooms are left on at all times during clubhouse opening hours. Motion sensors are the perfect solution here. Spot lighting in the ladies locker room alone is estimated to be costing the club £104.58 per year. Replacing these with LED spot lights could reduce this figure ten fold to somewhere in the region of £10 per year.

Because there are skylights in these areas, it is unlikely that the full compliment of artificial lights currently in use are required during daylight hours. As such motion sensors could be installed in conjunction with light sensors to ensure only required lighting is switched on when someone enters the room.

Paper towels, hand towels, and hand dryers are all available within the locker rooms. Providing so many options is unnecessary, particularly regarding the hand towels which will need to be washed and dried on a daily basis. It is advisable to provide just one option here – the use of energy efficient electronic hand dryers is the preferred option, with paper towels being a secondary option.

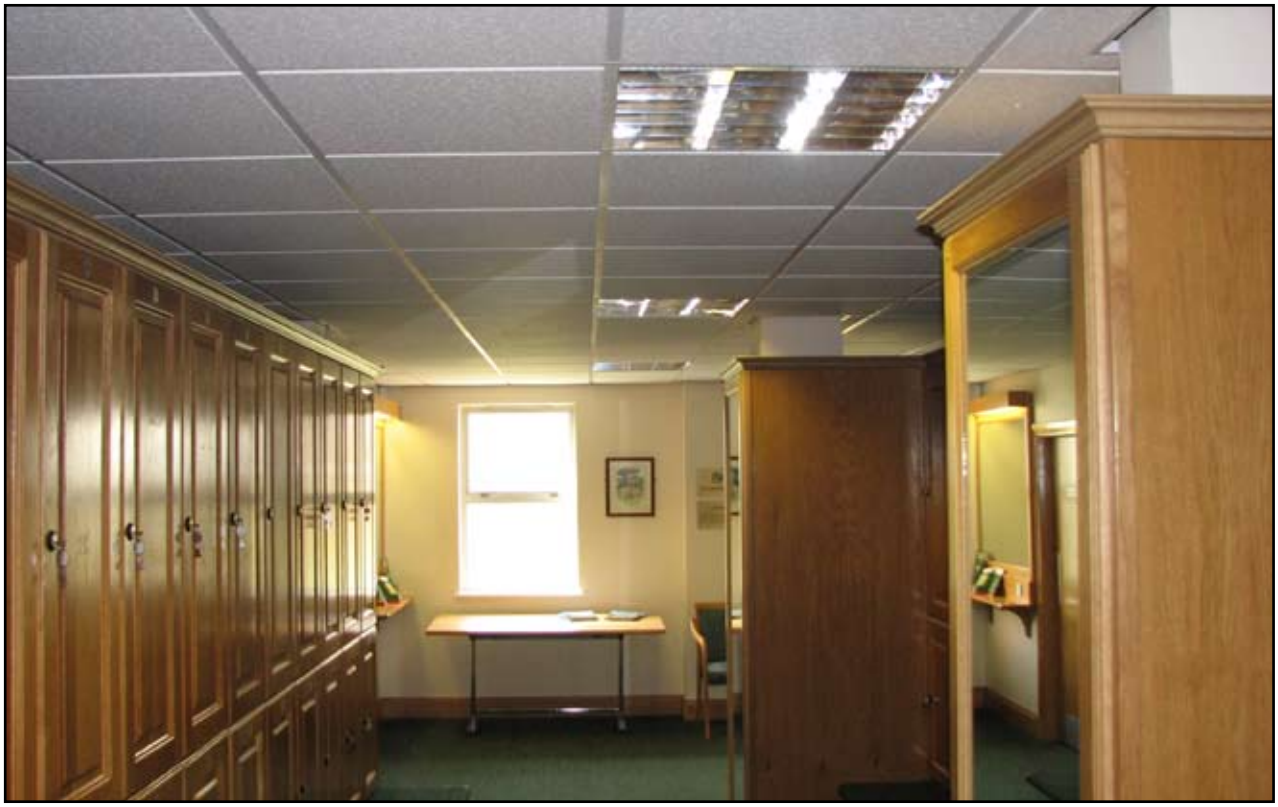
The drying rooms are a source of considerable energy use. It was noted that the drying rooms were in use at the time of STRI's visit despite the weather being hot and dry. The drying rooms should only be in use during periods of wet weather. The potential for energy saving here is significant.

The electric showers provided in both the ladies and gentlemen's locker consume a vast amount of energy and are estimated to be costing the club £3,028 per year. Highlighting this to the membership thorough signage and perhaps website notifications and encouraging users to keep the length of their showers to a minimum could significantly reduce the financial burden of these appliances.



Issue	Solution
Lights on when room unoccupied	Motion sensor / signage / introduce "light monitor" personnel.
Equipment left on or on-standby when not in use	Turn equipment off when not in use. Employ "switch me off" stickers as reminders
Poor insulation	Investigate improving window, door and roof insulation.
Some inefficient light bulbs remain	Replace all incandescent bulbs with energy efficient varieties
All lights on during day despite good natural lighting	Fit light level sensors and utilise flexible lighting
Paper towels, hand towels and hand dryers all available	Provide only energy efficient hand dryers. Use of hand towels = extensive energy use through washing operations.
Drying rooms demands considerable energy and is functioning all year round	Drying room should not be operational during periods of dry weather.
Showers are hugely energy demanding	Educate members and encourage minimal usage

5.8 LOCKER ROOMS – NEW BUILDING



The new building has the benefit of double glazing, thereby vastly improving its insulating properties. It was still the case however that lights were left on when the room was vacant and heating was on at an unacceptably warm level. This was particularly noteworthy given the warm outdoor temperatures of the day. All thermostatic radiators were noted as being set to their maximum level.

Lighting above mirrors was also left on when not in use. Given the close proximity of the mirrors to windows these lights are unnecessary during daylight hours and should therefore be able to be activated independently of the main lights.

Issue	Solution
Lights on when room unoccupied	Motion sensor / signage / introduce "light monitor" personnel.
Lights above mirrors not required during daylight hours	Fit independent switches for mirror lights
Heating on at very high level	Turn heating off during warm periods. Set thermostat at lower level.

5.9 MEETING ROOMS 1 AND 2

The two meeting rooms are in fact one large room separated by a partition. This in itself is a valuable energy saving device, reducing the amount of space required for heating when only a small meeting room is required.

The following comments apply to both meeting rooms:
The rooms are well insulated with double glazing throughout and well fitted doors. Lights were off when the room was vacant and the lighting installed is predominantly halogen spot lighting with differential controls for flexible use.

Of particular note was the heating which, although thermostatic in nature, was found to be on in both rooms despite them being vacant and the weather warm.

The main corridor providing access to the meeting rooms was found to have similar issues, with heating left on, although at a low level, throughout the day. Given the nature of this part of the building – i.e. a corridor purely used for access, the need for heating at all in this area is questionable. Given the thermostatic nature of the heating system it is possible, and advisable, to switch these radiators off on a permanent basis, with exceptions made only in extremely cold conditions.

The halogen spotlights within both meeting rooms are costing the club an estimated £175. Replacing these with LEDs could reduce this figure tenfold.

Issue	Solution
Heating left on when rooms not in use	Ensure thermostatic radiators are switch off unless room is to be used. Assign responsibility for this.
Heating left on in external corridor	Heating not required except for exceptionally cold periods given the nature and function of this part of the building
Halogen spotlights are inefficient	Replace all halogen bulbs with LEDs

5.10 CONFERENCE CENTRE

The conference centre at Woodhall spa was opened in 1998 and consists of a large conference room with associated bar and kitchen.

Table 8 (Appendix 2) lists all equipment in the conference centre and associated areas. Being a relatively new build, the centre is well insulated with double glazing and cavity wall insulation throughout. Lights were not left on unnecessarily and heating was provided by storage heaters. Lights had differential controls and motion sensors are not thought to be necessary in this area, with the exception of the lavatories. The installation of energy efficient light bulbs throughout would result in noticeable energy savings.

A bar is situated within the main conference room. Equipment was not left on unnecessarily. It was noted that drinks chillers were left on 24 hours a day. It may be the case that the installation of timers is a viable option to ensure that power is only delivered to the chillers when necessary.

The conference centre also supports an extensive and well stocked kitchen incorporating, amongst other things, two dishwashers, two microwaves, two fridges, two freezers, and a water heater. All of these items consume a considerable amount of electricity and care should be taken to ensure that they are only used when necessary. For example, fridges and freezers should only be required during days when functions are to be held. There may be periods where the conference centre is not used and fridges and freezers are not required. At the very least, there is likely to be periods when chilled / frozen food can be consolidated into one fridge/freezer, rather than having two half full.

The corridor feeding the main conference centre receives a considerable amount of natural light from its extensive double glazed windows. It is envisaged that artificial lighting is rarely required during daylight hours and light/motion sensors would be a positive addition here. Energy efficient lighting should be fitted throughout these areas.

Heating within the corridors was found to be off at the time of the visit.

The boilers feeding the conference centre are thought to be approximately 11 years old. Although relatively new, more efficient boilers are now available however the benefits of installing a new boiler system at this time do not outweigh the costs. This is, however a consideration for the future.

A final point regards the ladies lavatories within which heating was found to be on, despite the weather being warm and the conference centre being essentially vacant.

Issue	Solution
Some inefficient light bulbs remain	Fit energy efficient light bulbs throughout
Bottle fridges left on 24 hours a day	Fit timers to ensure fridges only operational when required
Considerable amount of energy consuming equipment within kitchen	Ensure all equipment is only switched on when necessary. Assign responsibility to someone
Large number of fridges / freezers	Potential to turn of one or more fridge/freezer at certain periods when demand for catering is not high
Artificial lighting rarely required during daylight hours in main corridor	Fit light/motion sensors
Potential for lights to be left on in lavatories	Fit motion sensors
Heating left on in lavatories despite good weather	Ensure thermostats are set correctly / heating is switched off when rooms not in use
Boilers in excess of 10 years old	More efficient boilers are available. A cost/benefit analysis would be necessary prior to any action on this point

5.11 PRO'S SHOP

The pro's shop provides the golfer with course information and equipment. The shop is situated within the 1995 building at Woodhall Spa. As such it is well insulated and double glazed throughout.

Table 9 (Appendix 2) lists all electrical equipment within the Pro's shop. Lighting is largely in the form of strip lights and these should be replaced with energy efficient varieties. Differential controls are in place.

There is a large amount of electrical equipment within the Pro's shop including several computers and drinks fridges, all of which should be turned off when not in use. The fridges should be fitted with timers to ensure they turn on in time to be effective when the shop opens, whilst preventing the current necessity to leave them on over night. Computers, monitors and printers should not be left on standby and electronic advertising boards should only be turned on during opening hours.

Issue	Solution
Some inefficient light bulbs remain	Replace all incandescent bulbs with energy efficient varieties
Large amount of electrical equipment – potential to be left on when not required	Ensure all equipment is off at mains when not in use. Assign responsibility
Drinks cooler on 24 hours a day	Fit timers to ensure cooler only operational when necessary

6.0 GOLF COURSE MAINTENANCE

As the highest energy user at a golf club, attention is generally focused on the clubhouse but energy, cost and carbon savings can be made through changes to golf course maintenance practices and facilities.

6.1 MACHINERY USE

The diesel receipts for the club show that 19701 litres of diesel were delivered to site in 2008. Petrol is also used for small items of equipment and bought in small jerry cans (estimated at 800 lires for 2008). This fuel is used exclusively to run course maintenance vehicles. The use of these vehicles is essential to maintain the golf club and it is unlikely that use can be reduced significantly. However, some simple measures could be implemented to reduce fuel consumption:

- Ensure vehicle tyres are correctly inflated to maximise fuel efficiency
- Schedule work tasks so that work requiring the same vehicle or piece of equipment can be completed together and in similar areas of the course to reduce unnecessary travel between tasks and multiple trips to and from the storage sheds
- Consider fuel efficiency when purchasing new equipment or replacing old equipment
- Do not leave transport vehicles idling when completing work on site
- Evaluate mown areas of the golf course. Do all areas currently mown need to be? Could some areas be managed as tall rough? Reducing mowing frequency in these areas reduces fuel use and can also have wider environmental benefits.

6.2 IRRIGATION AND WATER USE

The golf courses at Woodhall Spa are served by an automatic irrigation system with water being predominantly sourced from two on-site irrigation lakes.

Reducing water use on the golf course will save the club money in terms of electricity usage required for the irrigation pumps. Several measures for reducing water use could be adopted:Consider handwatering of greens and highspots

to reduce the need for automatic irrigation

- Check sprinkler heads and pipes frequently to improve resource efficiency
- Irrigate the golf course based on weather conditions, i.e. to replace water lost through evaporation, rather than routinely irrigating or irrigating on the basis of time rather than water volume.
- Install correct sprinkler heads for the situation, e.g. 180º sprinkler heads at the edge of maintained areas that reduce overthrow of water to non-target areas
- Consider grass species within playing surface such as tees and greens and perhaps switch to more drought tolerant species.

In addition to fuel use, machinery also requires energy during daily cleaning routines. Maintenance machinery at Woodhall Spa Golf Club is washed down using the installed ESD Waste2Water mechanical water recycling unit. This unit effectively cleanses washdown water removing chemical residues and nutrients and, as the water is recycled, also reduced the amount of water required by the Club each year. However this recycling unit does require a constant supply of electricity to sustain the microbes used in the system and this constant energy is likely to be significant when considered on an annual basis. However quantifying this energy consumption on-site was not possible as this would have required temporarily switching the unit off.

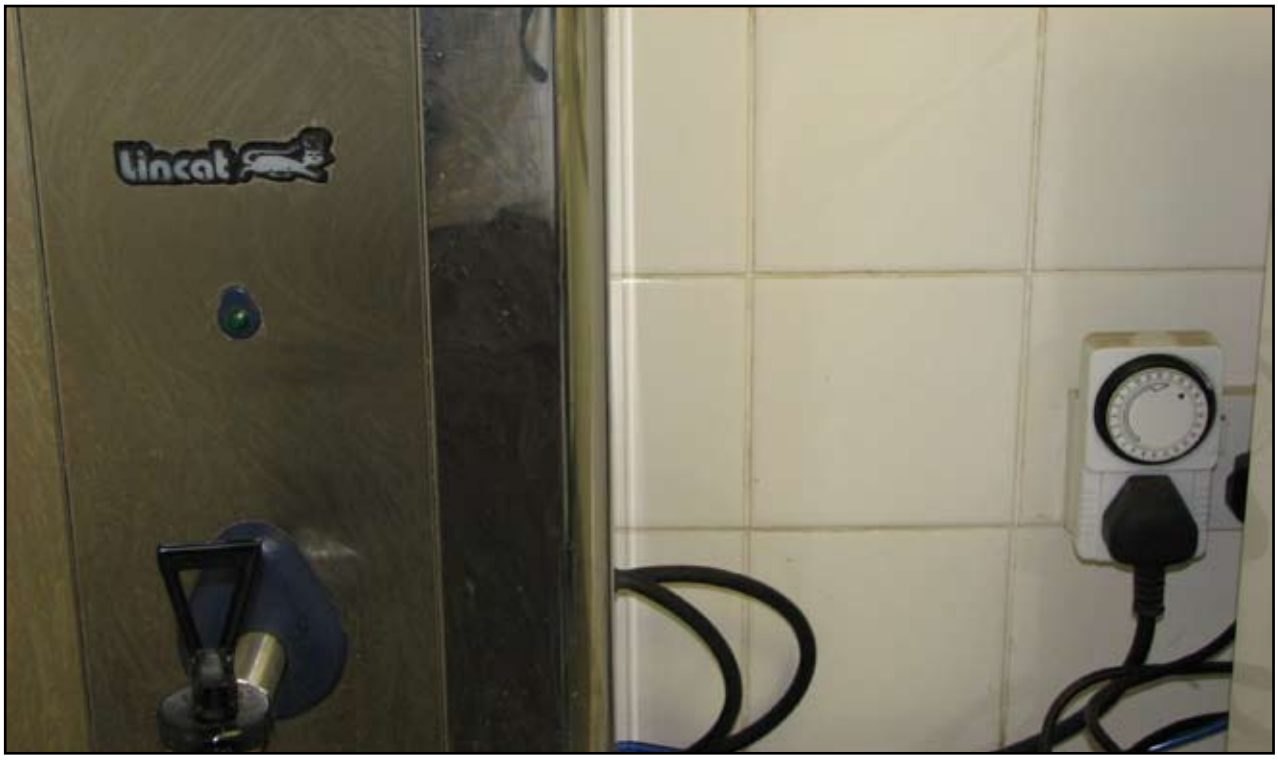
6.3 MAIN GREENKEEPING FACILITY

Table 10 (Appendix 2) lists electrical equipment within all maintenance buildings at Woodhall Spa. The maintenance compound comprises a large hanger for equipment storage together with associated offices, mess room, kitchen and shower block. The compound was constructed in 1998.

The compound is heated by a wood burning stove but also has central heating installed within office areas.

Lights have differential controls however lighting was noted as being left on in the kitchen and offices when vacant. Motion sensors would be appropriate for these areas.

The kitchen area contains amongst other things two microwaves a dishwasher and two toasters. There is also a water boiler which was noted as being connected to a timer. This is a very positive initiative although it was noted that the timer was set to switch the boiler on at 2am – which it is felt is a little premature.



The offices contain a variety of electrical equipment which should not be left on / on standby when not in use. Given the nature of the greenstaff movements (i.e. much of the day is spent outside on the golf course), the policy should be to turn off all computers that are not require to power golf course systems (irrigation etc).

Issue	Solution
Lighting left on in kitchen and offices when vacant	Fit motion sensors / "switch it off" signage. Assign responsibility
Timer fitted to water boiler yet set incorrectly	Set timers to ensure minimum amount of energy is utilised
Equipment in offices/kitchen left on standby when not in use	Ensure all equipment is switched off at mains when not required

6.4 BRETT'S COTTAGE

An out-building of the maintenance compound, Brett's cottage contains a series of fluorescent strip lights which could be replaced with more energy efficient varieties. It is appreciated however that this building is seldom in use.

Issue	Solution
Lighting is not energy efficient	Fit energy efficient bulbs

6.5 HALF-WAY HOUSE

The half way house offers light refreshment to golfers mid-way through their round.

When not in use, lights and equipment are switched off within this building.

6.6 DRIVING RANGE

The driving range incorporates an, office, foyer and lavatory. There are numerous strip lights within the complex which should be converted to low energy bulbs. The golf ball dispensing machine is likely to use large amounts of electricity when utilised, however it is unlikely that more efficient versions of this kind of equipment are available.

The water cooler within this complex should be fitted with a timer, to ensure operation only when necessary.

Issue	Solution
Water cooler switched on 24 hours a day	Fit timer to ensure cooler only operational when required
Lighting is not energy efficient	Fit energy efficient bulbs

7.0 CONCLUSIONS

The carbon and energy audit provides a detailed assessment of the various facets of the golf club and golf course operations at Woodhall Spa Golf Club. The room by room analysis provides a quantitative assessment of the energy used in each area and highlights where potential energy, carbon and cost savings can be made. The 2008 carbon footprint for the club allows the club to assess future changes and future progress, relative to the 2008 baseline, in reducing the impact of the clubs operations on the environment.

Appendix 1

List of Golf Course Machinery at Woodhall Spa Golf Club

Diesel Machines

4 x Toro 3250 greens mowers (2x2004 2x2007)
3 x Toro 3200 greens mowers (1997)
2 x Toro 3500 rotary mowers (2003,2005)
2 x Toro 5610 fairway mowers (2007)
1 x Toro 6500 fairway mower (2003)
1 x Toro 4500 rotary mower (2003)
1 x Toro multipro sprayer (2006)
1 x Toro 3000D rotary mower (1997)
3 x Toro 3300D workman (1998,2005,2007)
2 x Cushman utility vehicles (1991,1995)
1 x Isuzu Rodeo Denver 2.5L pick up (2006)
1 x Etesia (2007)
1 x John Deere 855 tractor (1994)
1 x Iseki 545 tractor (1993)
1 x New Holland Boomer 3045 tractor (2009)
1 x Kubota ST30 tractor (1999)
1 x Kubota L3600 tractor (1998)
2 x Kubota L4200 tractor (1996,1997)

Petrol Machines

6 x Toro GM 1000's greens mowers (1998)
3 x Toro GM flex 21's greens mowers (2003)
3 x Toro Gm flex 21's greens mowers (2009)
1 x Toro 3020 sand pro (1998)
1 x Toro 648 aeration machine (2007)
1 x Atilla brush cutter(2006)
6 x Stihl 036 chain saws (1998-2006)
9 x Stihl FS55 strimmers (2004-2009)
4 x Stihl hand held blowers (2006-2009)
2 x Stihl hedge cutters (2004)
1 x Vermeer 206 stump grinder (2004)
1 x Ryan renothin (1997)
1 x Sisis autorake (2000)
1 x Honda 536 rotary mower (2005)
3 x Billy Goat push blowers (1998,2000,2005)

Electric Machines

4 x Toro E2050 workman utility vehicles (2004)

Year of purchase in brackets.

Appendix 2

Woodhall Spa Golf Club Equipment Audit

TABLE 1: Old Clubhouse Kitchens			
Electricity			
Type of equipment or bulb	**Number**	**Total kWh**	**Cost (£/year)**
Toaster	2	38570.40	3201.34
Water boiler	1	24544.80	2037.22
Sandwich toaster	1	21038.40	1746.19
Dishwasher	1	6519.71	541.14
Microwave	3	6138.94	509.53
Freezer	1	4303.23	357.17
1.5 m strip lights	15	3813.21	316.50
Toasting grill	1	3287.25	272.84
Freezer	2	1490.22	123.69
Bug catcher	2	1327.17	110.16
Fixed air con unit	1	1022.70	84.88
Large freezer	1	471.14	39.10
Incandescent bulb	1	262.98	21.83
Vacuum cleaner	1	255.68	21.22
Walk talkie chargers	4	136.75	11.35
Fluorescent 'ring' bulbs	1	122.72	10.19
Incandescent bulb	1	109.58	9.09
Fridge	1	56.10	4.66
Deep fat fryer	1	54.79	4.55
Potato rumbler	1	45.66	3.79
Order printer	1	29.80	2.47
Card reader	1	43.83	3.64
Till monitor	1	22116.62	1835.68
Till drawer	1	43.83	3.64
Mixer	1	?	?
Large fridge	1	?	?
Large fridge	3	?	?
Large fridge	1	?	?
Mobile air con unit	1	?	?
Fixed electric heater	1	?	?
Extractor fan	1	?	?
Dryer	1	?	?
Washing machine	1	?	?
Large freezer	1	?	?
Chest freezer	1	?	?

Gas			
Type of equipment or bulb	**Number**		
Spider gas burners	15		
Grill	1		

TABLE 2: Old Clubhouse Bar and Beer Cellar			
Electricity			
Type of equipment or bulb	**Number**	**Total kWh**	**Cost (£/year)**
Old clubhouse bar			
Tills	2	4423.32	367.14
Halogen spotlights	14	3259.86	270.57
Glasswasher	1	3122.89	259.20
Drink pumps	2	547.00	45.40
Dustbuster	1	0.40	0.03
Security monitors	1	?	?
Sky box	1	?	?
Small fridge	1	?	?
Large fridge	1	?	?
Drink pumps	1	?	?
Drink pumps	1	?	?
Card reader	1	?	?
Receipt printer	2	?	?
Small fridge	1	?	?
Beer cellar			
Main beer cooler	1	3666.82	304.35
Flourescent 2d square bulb	2	40.91	3.40
Room chiller	1	?	?
Ice fridge	1	?	?
Gas beer pumps	7	?	?

TABLE 3: Dining Area 1 – closest to the kitchen

Electricity

Type of equipment or bulb	Number	Total kWh	Cost (£/year)
Hot cupboard	1	12316.23	1022.25
Halogen spots	14	3259.86	270.57
Small ping pong light bulbs (chandeliers)	10	2191.50	181.89
Fan lights	6	1314.90	109.14
Display chiller	1	1306.20	108.41
Cup warmer	1	940.15	78.03
Strip light	3	723.20	60.03
Hot water heater	1	624.58	51.84
Small ping pong light bulbs (chandeliers)	15	575.27	47.75
Side lights	9	542.40	45.02
Picture light	1	164.36	13.64
Till	1	?	?
Card reader	1	?	?

TABLE 4: Dining Area 2 – linked to the bar

Electricity

Type of equipment or bulb	Number	Total kWh	Cost (£/year)
Halogen spots	49	11409.50	946.99
Side lights ping pong	24	5259.60	436.55
Desk lamps	5	547.88	45.47
Strip light	1	197.24	16.37
Picture light	1	164.36	13.64
Fluorescent 2d square bulb	1	153.41	12.73
TV	1	72.94	6.05
Desk lamps	1	60.27	5.00
Electric fan	1	?	?

TABLE 5: Secretary's and Admin Offices			
Electricity			
Type of equipment or bulb	**Number**	**Total kWh**	**Cost (£/year)**
Secretary's office			
Halogen spots	6	530.4	44.02
PC	1	416.0	34.53
Scanner	1	46.8	3.88
Printer	1	6.9	0.57
Server	1	?	?
Adjoining office			
Strip bulb	12	898.6	74.58
Printer	1	645.6	53.59
Computer	1	364.0	30.21
Scanner/fax/phone	1	319.1	26.48
Small fridge	1	123.6	10.26
Laminator	1	40.3	3.35
Walkie talkie charger	1	30.1	2.50
Monitor	1	8.3	0.69
Catering office			
Printer	1	482.4	40.04
strip bulb	1	145.6	12.08
Computer	1	85.3	7.08
Monitor	1	49.1	4.07
Laminator	1	40.3	3.35
Phone + charger	1	35.9	2.98
Shredder	1	6.5	0.54

TABLE 6: Small Office			
Electricity			
Type of equipment or bulb	**Number**	**Total kWh**	**Cost (£/year)**
Printer	1	482.4	40.04
strip bulb	1	145.6	12.08
Computer	1	85.3	7.08
Monitor	1	49.1	4.07
Laminator	1	40.3	3.35
Phone + charger	1	35.9	2.98
Shredder	1	6.5	0.54

TABLE 7: Locker Rooms and Toilets			
Electricity			
Type of equipment or bulb	**Number**	**Total kWh**	**Cost (£/year)**
Ladies toilets conference centre - downstairs			
Strip lights	8	52.6	4.37
Fluorescent 2d square bulb	4	20.5	1.70
Ladies toilets conference centre - upstairs			
Strip lights	3	19.7	1.64
Fluorescent 2d square bulb	2	10.2	0.85
Ladies changing rooms			
Electric shower	2	14593.2	1211.24
Strip lights	7	2684.6	222.82
Hand dryer	1	1200.7	99.66
Halogen spots	4	931.4	77.31
Strip light in drying room	1	383.5	31.83
Picture lights	2	328.7	27.28
Spots (incandescent)	1	328.7	27.28
Strip lights	1	317.8	26.37
Fan heater	1	7.3	0.61
Curlers	2	7.3	0.61
Gents toilets adjacent to meeting rooms new building			
Hand dryer	1	1753.2	145.52
0.5m strip light	2	197.2	16.37
Fluorescent 2d square bulb	1	153.4	12.73
Extractor fan	1	?	?
Gents locker room			
0.5 m fluorescent strip	42	4141.9	343.78
Hand dryer	1	1753.2	145.52
Fluorescent 2d square bulb	9	1380.6	114.59
1.5 m strip light	2	635.5	52.75
1 m strip light	2	394.5	32.74
Extractor fan	6	?	?
Hydrostatic showers			
Gents locker room old clubhouse			
Hand dryer	1	2629.8	218.27
Low energy bulbs	14	843.7	70.03
1m strip lights	4	788.9	65.48
2 m strip light	1	547.9	45.47
Fluorescent 2d square bulb	3	460.2	38.20
keypad	1	?	?
Shower	3	?	?

TABLE 8: Conference Room and Kitchens			
Electricity			
Type of equipment or bulb	**Number**	**Total kWh**	**Cost (£/year)**
Freezer	1	6307.1	523.49
Water boiler	1	5290.6	439.12
Drinks chiller	1	5060.6	420.03
Till monitor	1	4607.6	382.43
Hot cupboard	1	3811.4	316.34
Dishwasher	1	2173.2	180.38
Strip lights	30	1972.4	163.71
Sup pots	2	1761.2	146.18
Glo-ray	1	1525.6	126.63
Microwave	2	1351.4	112.17
Hotplate	1	772.5	64.12
Microwave	1	438.3	36.38
Kitchen lights (incandescent)	3	328.7	27.28
Wharfedale speakers	4	65.7	5.46
Card reader	1	9.3	0.77
Till drawer	1	9.1	0.76
Order printer	1	6.2	0.52
Coffee machine	2	5.5	0.45
Seinheiser microphone and sound system	1	4.0	0.33
Coffee machine	1	2.7	0.23
Electric storage heater	?	?	?
Aircon/fans	?	?	?
Strip lights	54	?	?
Halogen spots	20	?	?
Drinks chiller (double)	1	?	?
Freezer	2	?	?
Bug catcher	?	?	?
Aircon unit	?	?	?
Dishwasher	1	?	?
Freezer	1	?	?
Deep fat fryer (twin)	1	?	?
Grill	1	?	?
Oven	1	?	?
Display cupboards	Various	?	?

TABLE 9: Pro's Shop			
Electricity			
Type of equipment or bulb	**Number**	**Total kWh**	**Cost (£/year)**
Coffee machine	1	3837.3	318.50
Short strip lights	4	1753.2	145.52
Halogen spots	13	1519.4	126.11
Strip lights	14	1472.7	122.23
Strip lights	6	631.2	52.39
Short strip lights	6	631.2	52.39
Photocopier	1	545.7	45.29
Small grey fridge	1	526.0	43.65
Printer	1	482.4	40.04
Printer	1	482.4	40.04
Walkie talkie charger	2	350.6	29.10
Computer	1	119.8	9.94
Computer	1	119.8	9.94
Monitor	1	116.9	9.70
Flourescent 2d square bulb	1	81.8	6.79
Monitor	1	69.0	5.72
Monitor	1	69.0	5.72
Footjoy revolving shoe	1	14.9	1.24
Electric fan	1	13.1	1.09
Water cooler	1	12.3	1.02
Drinks cooler	1	2.5	0.21
Caddy battery charger	6	1.0	0.09
Drinks cooler	1	?	?
Till + monitor	1	?	?
Security monitor	1	?	?
Monitor	1	?	?

TABLE 10: Maintenance Compound			
Electricity			
Type of equipment or bulb	**Number**	**Total kWh**	**Cost (£/year)**
Maintenance area - workshop and storage areas			
2m strip light	24	7012.8	582.06
Maintenance area - offices/showers etc			
Water boiler	1	25395.1	2107.79
Fridge	1	5689.1	472.20
Fax	1	5470.0	454.01
1m strip lights	25	2629.8	218.27
Electric shower	1	2432.2	201.87
Dishwasher	1	840.1	69.73
Water cooler	1	657.5	54.57
Toaster	1	644.3	53.48
Microwave	2	584.4	48.51
Toaster	1	554.1	45.99
Flourescent 2d square bulb	2	163.6	13.58
PC	1	119.8	9.94
Printer	1	43.0	3.57
Extractor fan	1	?	?
Telephone	3	?	?
ESD waste to water	1	?	?
External security lights	1	?	?
Bretts cottage			
Water boiler	1	25395.1	2107.79
2m strip light	7	2045.4	169.77
1 m strip light	2	210.4	17.46

TABLE 11: Conference Rooms and Corridors			
Electricity			
Type of equipment or bulb	**Number**	**Total kWh**	**Cost (£/year)**
New building upstairs corridor			
Electronic door release	1		
0.5 m fluorescent strip	24	788.9	65.48
Meeting room 1 new building			
Halogen spot	14	1086.6	90.19
Meeting room 2 new building			
Halogen spot	13	1009.0	83.75
Corridor to conference centre			
Halogen spots	16	1241.9	103.07
0.5 m strip lights	18	526.0	43.65
0.25 m strips	2	58.4	4.85
Dumb waiter	1	Out of service	Out of service
Boiler room			
2m strip light	1	182.6	15.16
Foyer of conference centre			
Halogen lights	12	931.4	77.31