Linacre College: Carbon Reduction Strategy

Introduction

This Carbon Reduction Strategy for Linacre College sets out the principles that will guide our actions to reduce carbon emissions, together with our aims and specific targets, and the approaches we will take to achieving them over the next 10 years. It has been developed in collaboration with students, staff and fellows of the College, and has been endorsed by Linacre's Governing Body. The evidence to inform development of the Strategy has been drawn from a wide range of sources, including a survey of College members' views, and audits of energy use at Linacre by the Environmental Change Institute, the Carbon Trust and the University's Energy Manager.

Aims and principles

In developing this Strategy, students, fellows and staff at Linacre College recognise climate change as a key, global issue and accept the need for the developed world to show leadership in substantially and urgently reducing emissions of greenhouse gases. The Strategy also reflects Linacre's reputation as a 'green' college at Oxford, an important factor in its selection by many of our students, and a commitment to maintain our leadership on sustainability issues amongst the Oxford colleges.

Our aim, therefore, is to drive down Linacre's carbon emissions as quickly as possible, consistently with the resource constraints faced by the College. Our initial focus will be on the carbon emissions arising from energy usage on Linacre's main site and its offsite student houses. We will establish minimum energy performance standards to which all investments made in Linacre's building stock must conform. Over time we will extend the scope of our initiatives on carbon reduction to address 'embodied carbon' in the goods and services consumed through College activities, and to include College related, but offsite activities, such as travel.

A key challenge will be to develop and sustain the enthusiasm and commitment of students, fellows and staff necessary to achieve the demanding targets set out in this Strategy. We will draw on the breadth and depth of relevant knowledge and skills represented in the College membership to enable its successful delivery, and we will seek to galvanise an effective synergy between the intellectual and practical endeavours of College members. We will also work with other Oxford colleges and the University to share experiences and develop best practice.

Our target

We will reduce carbon emissions compared to 2009 levels by 40% by 2020, i.e. over a ten year time period. This will take us half way towards our longer term target of an 80% reduction consistent with the UK's energy goals.

This 40 % target is demanding but achievable, and provides a focus for our short to medium term activities. It applies to the energy used on the main College site together with that used in its student buildings off-site, but does not include the 'embodied carbon' in the goods and services used by the College. A study will be carried out to establish the levels and sources of this embodied carbon so that reduction targets, and a plan to meet them, can be developed.

An energy audit of the St Cross Road site in 2007 revealed that the buildings, taken together, use more energy than is typical for their class, the main building being a particularly poor performer. While the Abraham and Bamborough buildings perform better than the relevant benchmark, they still fall some way short of the 'gold standard' developed by the Association for Environment-Conscious Building. This suggests that achieving the target is feasible from a technical point of view. The age of the off-site student houses and the fact that they have not been subject to major energy saving refurbishment, suggest that here too there is sufficient scope to achieve the targeted savings.

The target should be achieved through a combination of investments in energy saving measures and through good housekeeping measures by residents and users of the College buildings. Energy saving investments will need to meet financial criteria established by the College's Finance Committee, which will reflect the central and strategic position of our commitment to sustainability. Investments will therefore pay for themselves over time through savings in the College's energy bills, particularly as energy prices rise as they are expected to do over the next decade.

In addition to setting targets relating to the annual rates of carbon emission, the long residence time of CO_2 in the atmosphere and the potential for 'tipping points' in the earth's climate to be reached by mid-century, mean that it is appropriate also to set a target for Linacre's cumulative release of carbon over the ten year period to 2020. This target will need to be established in light of further consideration of a feasible schedule of energy saving measures over the next 10 years, but should be pitched at a level that maintains the pressure for significant annual reductions in carbon emissions.

Monitoring and management

Having sufficiently reliable and detailed information on energy use is an essential first step, providing the basis for management initiatives to reduce it. The aim is to relate energy use to key factors such as occupation and weather to enable a better understanding of how energy is being used and identify opportunities for energy reduction.

Additional meters will be required, recording energy use at regular intervals (potentially half-hourly), at individual building or landing level, and for areas which use energy intensively such as the kitchen. In the longer term, metering may be extended to individual rooms as discussed in the section on achieving longer term targets. Data from the meters will need to be adjusted to reflect weather conditions (in particular temperature) and the resulting information will need to

be collated and analysed in relation to important drivers of energy use such as occupation rates for residential areas and meals served for the kitchen.

A rolling action plan for an 18 month period will be developed, and updated annually, based on this Carbon Reduction Strategy. It will set out in more detail the specific initiatives and actions that will be taken according to an identified timetable, and will set targets for consequent reductions in energy use in individual areas. The action plan and progress against it will be communicated regularly to College members.

The development and implementation of this action plan will be the responsibility of the Domestic Bursar's Office. The Linacre Sustainability Committee will provide advice as requested, and will monitor progress on implementation and achievement of targets. Recognising the need to access professional expertise on energy management, the College will consider how best to source the services of a professional energy manager. One option would be to collaborate with a number of other Oxford colleges to employ a full-time energy professional. In addition, a 'green scholarship' has been proposed which would provide some financial support for a Linacre student in return for his or her devoting time to furthering Linacre's sustainability initiatives, including delivery of this Carbon Reduction Strategy.

Behavioural change will play an important role in reducing Linacre's energy use, but investments in the fabric of Linacre's buildings and the equipment they contain will be essential. The scale of the required investments will become more onerous as deeper cuts in energy use are targeted. While some of the necessary funding may be drawn from the College's operational budgets, additional sources of funds will be needed. They may include:

- Loans, potentially from low-interest Government schemes;
- Government grants for energy saving measures;
- Bequests: achieving a low-carbon Linacre may appropriately be an element of funding campaigns; and
- Using the anticipated savings in energy bills to fund energy saving schemes.

Achieving our targets

A central element of our efforts will be to develop and sustain a much higher level of energy use awareness in College members, and ensure that this is translated into day to day actions and habits to reduce energy. A particular challenge is the turnover of students at the College, and hence energy use, and what they can do to reduce it, needs to be addressed in their induction to the College, and continually reinforced during their time at Linacre. Our aim must be to generate enthusiasm for achieving our carbon reduction targets, and to ensure that sustaining our leadership on sustainability is an important and active part of our shared ethos as a Linacre community.

Achieving behavioural change in respect of energy use is generally recognised to be difficult, and we must engage effectively with students, fellows and staff to establish what will 'turn them on to turning things off'. It will be appropriate to trial approaches, possibly in connection with student research projects. Our aim should be that heating and lighting is only being used where benefit is being derived from it.

The second key strand of our activities will be investments in energy saving measures. The focus will be on initiatives that will maximise carbon savings for a given level of investment. Opportunities will range from the 'low hanging fruit' – relatively low cost measures with short payback times (table 1 lists some possibilities) – to more expensive and longer payback investments which will need to be considered if the 40% target is to be achieved (table 2 lists potential schemes in this category).

Choices between them will need to be informed by detailed analysis of what will be the best combination for Linacre, taking account of the particular infrastructure and energy needs of the College, and developments in technology performance, reliability and price. Another factor will be the 'carbon content' of the UK's electricity supply: if this reduces rapidly due to investments in non-fossil sources and carbon capture and storage, then options using electrical power sourced from the UK grid may be preferred. Given that energy consumption in the eight College houses, when taken together, is on a par with that of the main site buildings, they should be given a similar level of attention in energy saving initiatives.

Some options, particularly those concerned with modifications to the fabric of the buildings, may best be carried out in conjunction with alteration or refurbishment work undertaken for other reasons. However, given the intention to establish a target for cumulative releases of carbon to 2020, we should proceed with energy saving investments as quickly as funding sources allow, and consistently with judgements on when to 'buy-in' to new technologies as they mature. Also, care will need to be taken to ensure that modifications in the fabric and equipment of the buildings to achieve energy savings in the short term do not compromise our ability to make deeper cuts on longer timescales.

As we reduce our carbon emissions then 'embodied carbon', i.e. in the food we eat and the water we use, becomes relatively more important. Over this period it will therefore be appropriate to extend our carbon accounting and our initiatives on carbon reduction to embodied carbon.

First steps

Linacre has met its commitment to the "10-10" initiative (a widely supported current initiative in which organisations commit publicly to reducing their carbon emissions by 10% in 2010: see www.1010UK.org), providing good initial impetus for the College's ongoing endeavours to deliver the Carbon Reduction Strategy. Governing Body's approval of this strategy would be followed by a further round of planning to identify priority energy saving actions over the next 18 months.

Table 1: Relatively low cost measures for consideration in the short term

Investment	Comments
Heating controls: • Install tamper-proof thermostats in public areas and optimise settings • Replace/augment thermostats in student rooms as necessary to ensure that heating levels can be effectively controlled • Provide training to Maintenance Manager so that he can ensure that boiler controls are set optimally to extract the maximum useful heat from the energy input.	Recommended actions from the Carbon Trust survey. Optimising the settings on the main College boilers has the potential to save around 5% of gas consumption.
Lighting: • Complete replacement of incandescent bulbs with low energy bulbs • Convert fluorescent fittings to low energy T5 lamps • Replace dichroic spotlights with compact fluorescent lamps.	Recommended actions from the Carbon Trust survey which indicated that around 40% of the main site energy consumption is for lighting. High efficiency light fittings can save 50 – 80% compared to traditional fittings (but most of the College's incandescent bulbs have already been changed).
Roof void insulation: augment as necessary insulation in all roof voids up to recommended levels.	In a 'typical home' around 25% of the heat is lost through the roof. Recommended loft insulation thickness is now around 300mm, so substantial further savings are possible depending on how well insulated College buildings and houses are already. Costs are £10-40/m^2 making this a high priority option.
Install draft proofing on windows and doors.	Heat losses due to drafts can be substantial and have a negative impact on comfort levels. Relatively simple and cheap to install draft proofing measures may be a useful interim step prior to installing double glazing.
Commence programme of replacement of single glazed windows with double glazing: prioritising according to energy saving per £ invested.	Energy losses through single glazed windows account for 20% of heat losses from a 'typical home'. However, retrofitting double glazing is not a cheap option. Over this first three year period it may be appropriate to focus on windows needing to be replaced as repair costs have become uneconomic.
Fit automatic and/or motion sensitive switches in appropriate public areas such as corridors	

and bathrooms.	
Evaluate all white goods appliances, in particular fridges and washing machines, replacing with low energy models where payback can be achieved within an acceptable period.	Energy consumption of A rated appliances is around 50% of that of G rated appliances. It is therefore appropriate to survey the College's stock of 'white goods' to identify where replacement can yield an appropriate return. Also further savings can be achieved in their options through, for example, setting wash temperatures lower and optimising refrigerator/freezer settings.
Provide low energy alternative for clothes drying.	Investigate the potential to provide a drying room at the College main site and outdoor 'washing lines' at the College houses. And provide incentives/encouragement to use them.
Review energy use of appliances in the College main kitchen and in chiller rooms, replacing items where payback can be achieved within 5 years.	A review of energy use and appliances in the College kitchen and chiller rooms was identified as a priority in the ECI audit of Linacre energy use.
Re-locate IT server room to more energy efficient location	Oral recommendation made during Carbon Trust survey.

Table 2: More expensive investments in the fabric and equipment of the College buildings

Technology	Type of saving (see footnote)	Comments: potential savings and costs
Double glazing: complete double glazing of all main site and off-site buildings to high thermal standards.	Energy intensity	Typically, around 20% of the heat lost from houses with single glazing is through the windows. Poorly fitting windows and hence drafts (of which there are a significant number in the College's housing stock) can exacerbate this problem. Double glazed units can reduce energy losses through windows to 25-45% of that of single glazed units, and high efficiency triple glazed units can bring energy losses down to 10-15% of that of single glazed units. *Insert cost data from recent College quotes.*
Wall insulation: for the solid walls comprising most of Linacre's estate, install insulation internally or externally as appropriate.	Energy intensity	Around 30% of the heat lost from a 'typical home' is through the walls. With the exception of the Abraham and Griffith buildings, main site buildings and College houses are of solid brick construction (i.e. they do not have cavity walls). Application of insulation, externally or internally) can reduce energy losses through solid brick construction walls to 10% of their original values at a cost of around £150/m^2. However, there are obvious aesthetic issues for external insulation, and practical difficulties of space loss and moisture control for internal insulation.
Floor insulation: install floor insulation as appropriate in all main site and off-site buildings.	Energy intensity	For buildings with cellars, under floor insulation can be installed at costs similar to that of loft insulation, and consequently follows it as a high priority investment. Costs of insulating solid floors are substantially higher, which may consequently be most appropriately undertaken in conjunction with other refurbishment works.
Combined heat and power: an option for replacement of boilers in the main site and, at a micro-CHP level, in the off-site buildings.	Carbon intensity	Potential carbon savings are 10 – 15% of the carbon content of the heat/electricity replaced for a CHP plant on the main site and 5 – 10% for micro-CHP units in the College houses. However, these savings are dependent on the 'carbon content' of the electricity otherwise generated off-site which is replaced: as the UK electricity supply becomes de-carbonised the carbon savings from on-site CHP will decrease. The contribution of CHP is also limited by the need to size the plant in relation to the base-load heat demand through the year. Capital costs for a main site CHP plant obtained in 2007 were £200-240k. For micro-CHP, costs are typically in the range £3-5k per 1 kW electricity / 3 kW heat.
Condensing boilers: if a decision is taken not to install micro CHP in the off-site buildings consider installation of high efficiency condensing boilers.	Carbon intensity	Condensing boilers have efficiencies approaching 90%, compared to 70 – 80% for non-condensing boilers. It is now a legal requirement that they are fitted when replacing old boilers.

Heat pumps: install ground-source heat pumps in main site and off-site buildings as an alternative to, or in conjunction with, CHP or condensing boilers.		Heat pumps use electrical energy from a low temperature heat source (usually the air or the ground) and move it to the higher temperature heat sink (the building to be heated): they are essentially refrigerators in reverse. Ground source heat pumps are more expensive to install (pipes need to be buried in the ground), but are more efficient than air source heat pumps: they can provide a ration of useful heat to electrical energy input of 3 – 4.
Solar panels: install solar panels on main site and off-site buildings to provide part of the College's hot water demand	Heating services / carbon intensity	Solar panels are eligible for state funding. Savings of solar panels are moderate, but maintenance is very low. In general, solar panels come with a 10 year warranty and can work all year round, even in shady days and are especially efficient on large, sunny roof spaces. They require special boilers, but the new boilers on the main site are already equipped for the use of solar panels, which will greatly simplify the installation and save costs. Depending on the type of installed solar panel and hot water usage, savings are on average £6 on fuel costs and 31kg CO2 emission per year and square meter installed solar panel.
Photovoltaic panels: install photovoltaic panels to supply part of the College's electricity needs	Energy services / carbon intensity	Photovoltaic (PV) cells are eligible for state funding. Savings of PV cells are considerable good and maintenance is low. In general, the same rules for effective use apply as for solar panels, but in contrast to solar panels PV cells can be used to sell overproduced energy back to the grid for a good price. Depending on the type of the installed PV cells, savings are on average £25 on energy costs and 119kg CO2 emission per year and square meter installed PV panel.
Low energy appliances: continue to replace appliances with the most efficient models on the market.		A-rated appliances use around 50% of the energy of G-rated appliances.
"Personalised energy": individuals' energy consumption is individually metered and displayed to them in an appropriate form to inform their energy usage decisions. Potentially combine this with individual payment for energy used rather than it be rolled into a monthly rent), and/or a personal carbon allowance (with a scheme to buy extra units if needed).		Increased awareness of energy consumption, and a requirement to pay for one's own energy consumption where it can be broken out from more general site use, can encourage individuals to make savings.

Smart grids/meters: as smart metering / grids are developed and installed generally, adopt smart metering for the College so that devices which are capable of it can be turned on and off automatically to use electricity when it is available from renewable sources.	Energy services / carbon intensity	Through increasing awareness of energy use, smart meters can potentially support on-site energy savings of around 10%. In combination with smart grids and automated switching on/off of appliances to reflect real-time electricity prices they can contribute to supply-demand matching for the electricity system as a whole, and hence reduce the need for carbon-based generation to top-up renewable sources (carbon savings dependent on the specific characteristics of the future UK electricity system). The main investment – establishing a smart grid - will be made by the transmission system operator, who may also promote (and hence subsidise) the on-site costs of smart meters and automated switching.

Footnote:

- Energy service represents how much useful service we get from using energy
- Energy intensity is about the efficiency of the equipment we use to get the services we want (= 1/energy efficiency)
- Carbon intensity is about how much carbon is released to the atmosphere per unit of energy consumed.
- Carbon emission is the product of energy service, energy intensity and carbon intensity.