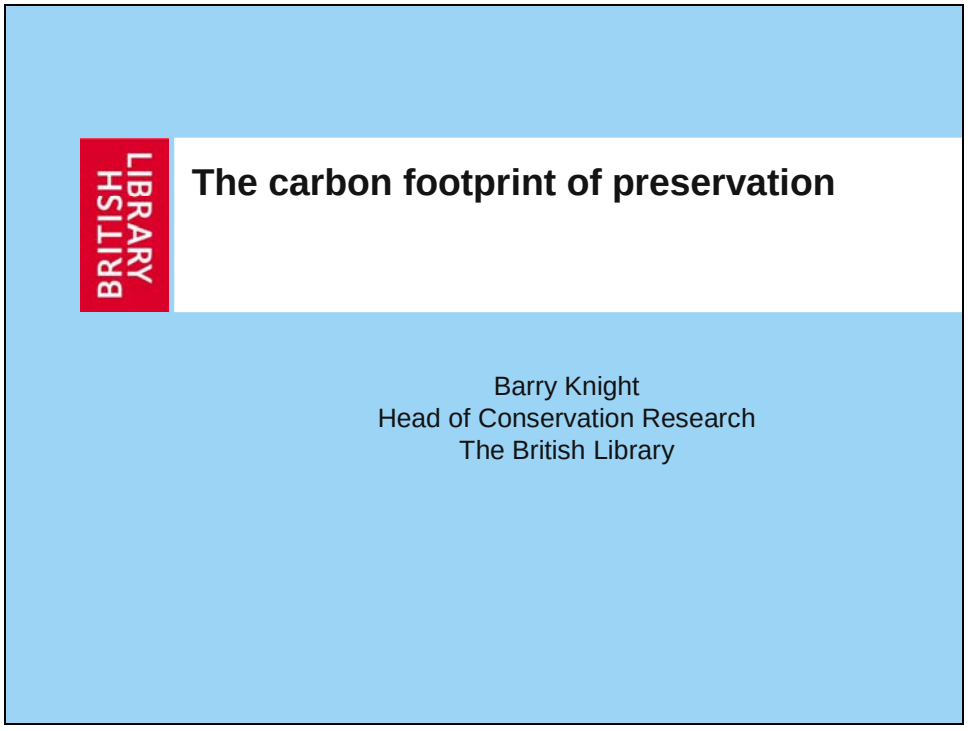
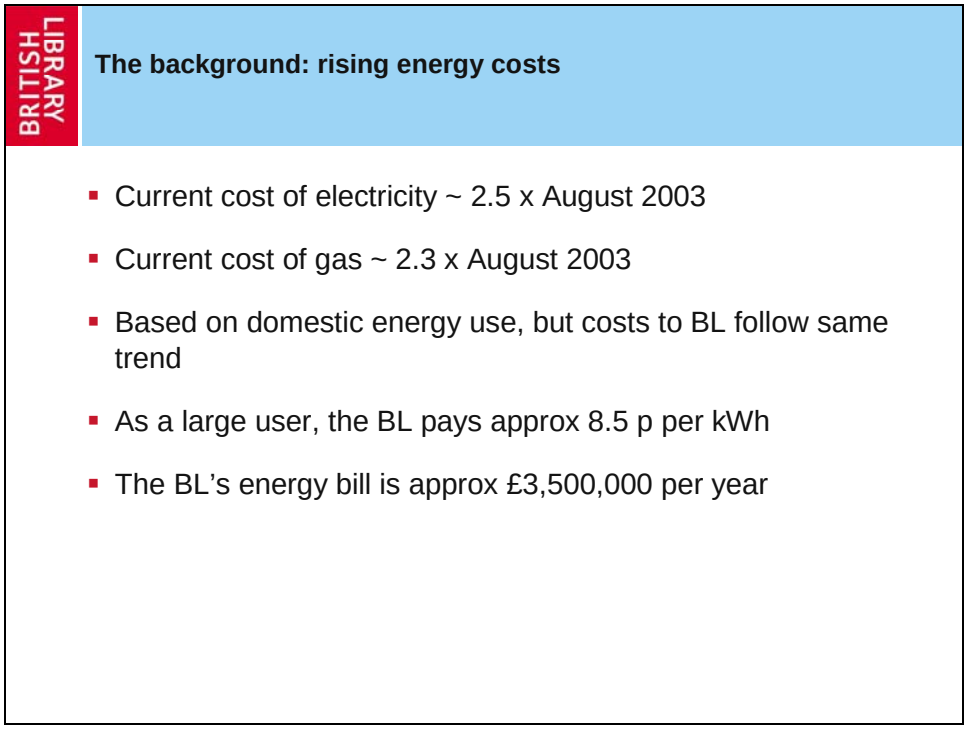


This is an introduction to some energy issues as they affect the BL. I'm going to start with general energy use and how it affects our carbon footprint, and what we're currently doing to reduce it. Then I'm going to talk about wider issues of energy use in the cultural heritage sector, and some current initiatives. After that, I want to look at a very specific live issue for us – the environmental specification for the Newspaper Storage Building at Boston Spa. Finally, I'm going to look briefly at the effect our continuously increasing digital collections will have on our energy use.



These figures are taken from the authoritative Ofgem Quarterly Price Report in August 2009. Although there have been blips in the price of gas and electricity, the general trend is upwards and this can be expected to continue.

Energy costs are a significant percentage of our annual Grant in Aid, so a 10% reduction, for example, would have a significant impact on our other activities. There is no doubt that our budget will be squeezed next year and in coming years.

The BL's carbon footprint

In 2006-07 we used:

- 30 GWh of electricity
- 10 GWh of gas
- 118 million litres of water

In 2006-07 we produced:

- 16,000 tons of CO_2 from electricity use
- 1,800 tons of CO_2 from gas use
- 32 tons of CO_2 from water use
- Just over 10 tons of CO_2 per employee

These are global figures for the whole of the BL estate, but St Pancras accounts for 72% of our total energy use.

In 2008-09 we reduced our electricity consumption to 25.4 GWh – a 15% reduction. Notice also that our carbon footprint resulting from electricity use is much greater than that from gas – nearly 3 times as much. This is because although much of our electricity is produced by burning gas, electricity generation is not very efficient.

You may be surprised that there is a carbon footprint associated with water use, but energy has to be used in purifying and pumping water, and in sewage treatment.

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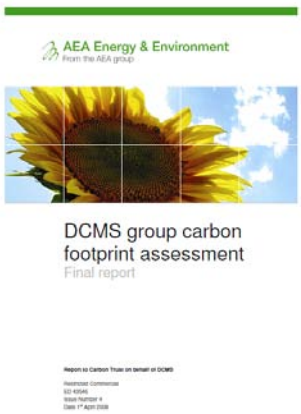
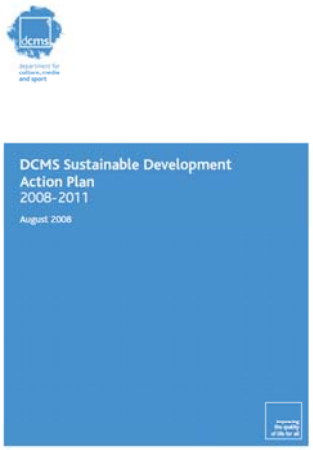
DCMS policy documents





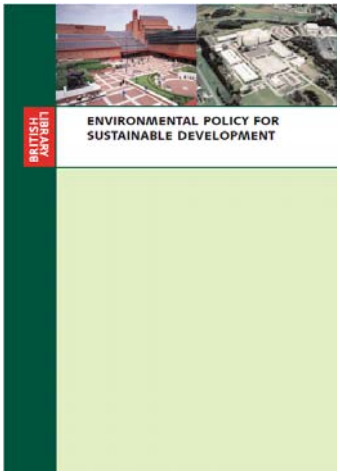
These two important documents were produced in 2008.

DCMS commissioned consultants to look at the carbon footprints of a number of its Non-Departmental Public Bodies (NDPBs), including the BL and several other museums and galleries. They reported in March 2008. This covered their gas, electricity and water usage, as well as their business travel. They found that it was difficult to get reliable data from many NDPBs, so there was a general need to improve monitoring, although the BL did have good energy use data. The BL's electricity use was the highest of all the cultural heritage institutions – twice the British Museum's, for example, but our gas use was lower than many others. Overall, our carbon footprint per employee was lower than many cultural heritage bodies: comparable with the British Museum, lower than the National Gallery, but higher than the V&A.

In response to this report, DCMS brought out its Sustainable Development Action Plan in August 2008. This set out the policy framework which DCMS would use to reduce its own carbon footprint, and that of its NDPBs.

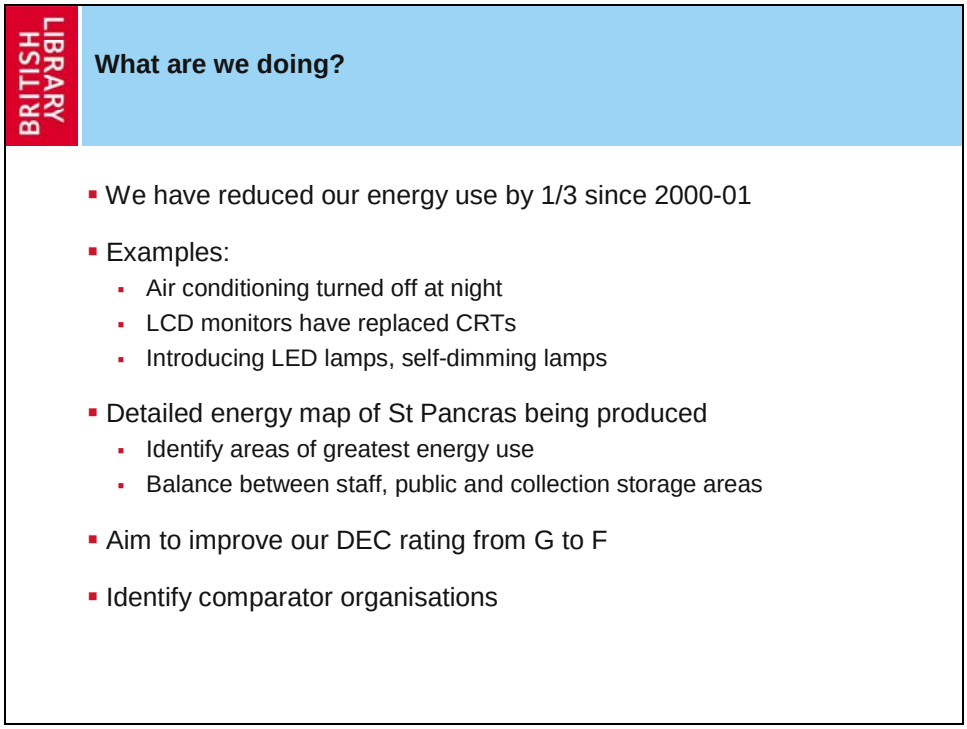
These documents were produced under the last government: we don't yet know what the new government's line will be, but we can expect a continued drive to reduce the carbon footprint of all museums and galleries as part of the general drive to reduce costs.

Inevitably …



- Energy prices will increase
- Budgets will shrink
- Since the BL has the largest carbon footprint of all the DCMS NDPBs, there will be additional pressure on us to reduce it

The BL had already produced its Environmental Policy for Sustainable Development in August 2005, and the DCMS Action Plan confirmed the consequences for the library.



If you have visited Basement 1 you will have seen the vast air conditioning plant there, and this consumes a large fraction of the electricity we use. However, since moving into St Pancras we have reduced our energy use by 1/3, partly by using the air conditioning more efficiently. For example, 21 air handling units are not being used.

A lot of electricity is used by lighting, and Estates are aiming to reduce this by replacing fluorescent tubes with LED equivalents. This has recently been done in the King's Library Tower, which I think you will agree looks much better now and is a real focal point of the Entrance Hall.

The perception is that St Pancras is an energy-intensive building with "Rolls Royce" systems, and we need to counter that. The Estates department is developing more sophisticated systems to control energy use, and these are having a considerable effect.

The BL's energy rating

- Our current DEC rating is G, meaning that we use 52% more energy than a "typical" building of the same size.
- We are assessed as part office, part storage
- IAMFA uses more realistic comparator buildings
- Would a different basis be more appropriate – eg energy use per m^3 or per linear km of storage?

Energy use	Actual (kWh/m^2/yr)	"Typical"
Heating (gas)	72	186
Electricity	201	83

The DEC is the Display Energy Certificate, which is required by law to be displayed by all large public buildings.

It aims to rate public buildings according to their energy consumption in kilowatt-hours per square metre per year. Our current rating is G, meaning that we use 52% more energy than a "typical" building of the same size. We aim to improve our rating to F, meaning that we use 50% more energy than a "typical" building, and we are nearly there, at around 52% more. IAMFA, the International Association of Museum Facilities Administrators, has developed its own comparators, which are more relevant to the BL, but we are obliged to use the DEC figures.

We need to identify more realistic comparator buildings, and I have contacted other national libraries to see if they have comparable figures for their energy use, so that we can see how well we perform against them. However, it is difficult to compare carbon footprints between nations, because each country uses a different mix of fuels for electricity generation. For example, in France, 85% of electricity comes from nuclear power stations, so 1kWh consumed in France has a much smaller carbon footprint than 1kWh consumed in Britain.

The bigger picture

- Initiatives by other institutions
  - Combined heat and power plant in South Kensington
- Initiative by National Museum Directors' Conference
  - Aims to reduce museums' carbon footprint by relaxing environmental guidelines for storage and display
  - Will facilitate loans between institutions
- Updating standards
  - BS 5454 will be updated
  - Publicly Available Specifications (PAS) for the storage environment for different materials will be produced
  - European (CEN) and International (ISO) standards will be revised

The V&A, Natural History Museum and Science Museum have a combined heat and power plant that provides heat and electricity to all three museums. This burns gas and has reduced their carbon footprint. Interestingly, this is going back to a concept that existed over 100 years ago, when there was coal-fired heating plant serving the three museums.

You may have heard about the initiative by the National Museum Directors' Conference – this is the body that represents the directors of the big museums in the UK, the British Museum, V&A and so on – to relax environmental guidelines for storage and display. This has come from the realisation that many new museum building projects may be wonderful architecture, but they have delivered buildings where it is very difficult to control the environment, or very expensive, or both. There is also the realisation that if every museum sets its own environmental guidelines for loans it gets difficult to put on a major exhibition where all the exhibits have different requirements. Certainly for a lot of inorganic objects – stone, ceramics and glass, for example – the environment does not have to be as closely controlled as it does for ivory or manuscripts.

BS 5454 will be updated to take account of developments in library and archive storage, such as the Additional Storage Building at Boston Spa. Specific guidelines will be produced for different classes of museum objects, because at present people tend to use the specifications in BS 5454 for everything, even though we know they are not appropriate for materials such as metals. The message is that one size does not fit all, and in fact we are starting to move away from this, with a dedicated cold store for microfilm masters, and our new mass storage buildings at Boston Spa.

The Additional Storage Building

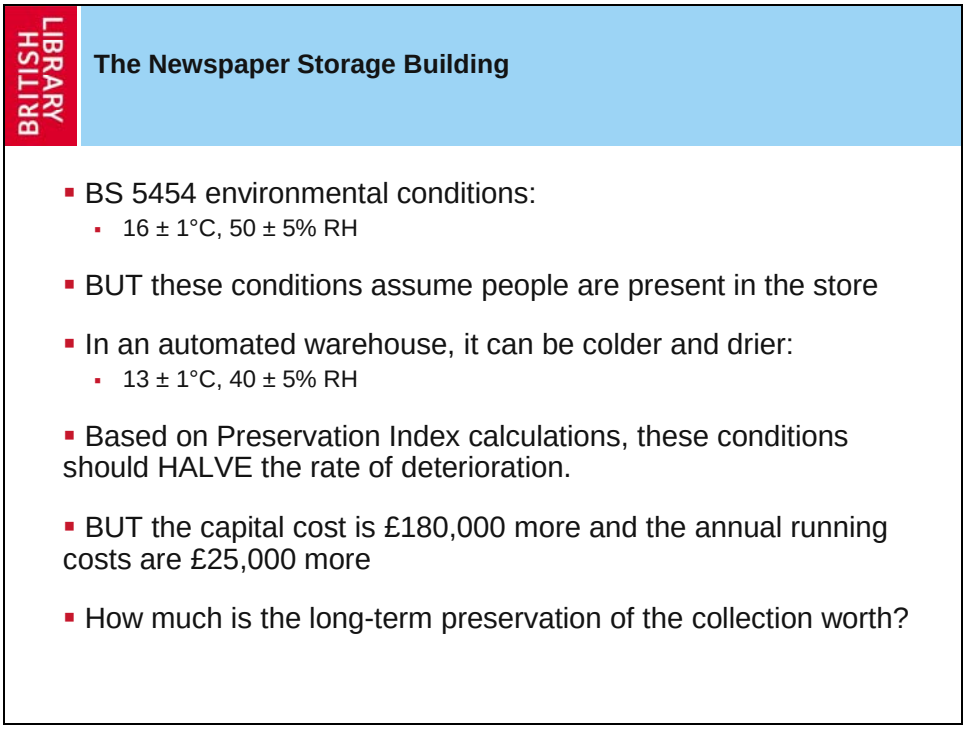
- Fully automated warehouse
- Will contain approx 1/3 of BL's collection once full
- Main uses of power:
  - Cranes and conveyors
  - Oxyreduct system
- Uses about 12% of BL's total electricity consumption

The Additional Storage Building was completed last year and is slowly being filled by emptying two low-grade stores in London. Once it is full it will contain about 1/3 of the BL's total collection, 262 linear km.

It is a fully automated warehouse: books are stored in large crates, so when a particular item is called the whole crate is moved out into a picking area where a member of staff removes the book and sends it down to London, while the crate is returned to the store.

The main uses of power in the building are for the electric cranes and conveyors that handle and transport the crates, and the Oxyreduct fire suppression system. Because the building is so large, 45m wide by 80m long by 25m high, and so densely packed, a conventional sprinkler system would not work. Instead we have chosen a reduced oxygen fire suppression system. This works by reducing the level of oxygen inside the store from the normal 20% to 15%. At this level it is not physically possible to start a fire, although it is possible to breathe – but in practice, there are no staff in the store. A bank of compressors force air through a semi-permeable membrane that removes the oxygen and produces a gas stream containing 95% nitrogen, which is pumped into the store.

Preliminary figures suggest that the ASB is consuming about 12% of the BL's electricity; however, it will contain about 1/3 of the total collection, so this sounds quite good. Once we have fully analysed the data from the energy mapping exercise we will be able to make a better comparison.



The next phase of our storage development at Boston Spa is the Newspaper Storage Building. It will contain all of the newspaper collections currently at Colindale in an automated warehouse. The idea is that eventually all the newspapers will be digitised, so there will be no need to access the hard copies.

At present we aim to maintain BS 5454 conditions in our stores, so in the basements here we have 19° and 50% relative humidity. However, the standard assumes that people are present in the store, so they need a reasonable working temperature. In an automated store, there are no people, so the temperature and the RH can be reduced. 13° and 40% RH are at the bottom of the specified range in BS 5454 for rarely-used material.

Preservation Index calculations suggest that these conditions should halve the rate of deterioration of the collection, but the capital cost is £180,000 more and the annual running costs are £25,000 more. How much is the long-term preservation of the collection worth? This is a difficult question to answer, but it is one that deserves to be looked at seriously.

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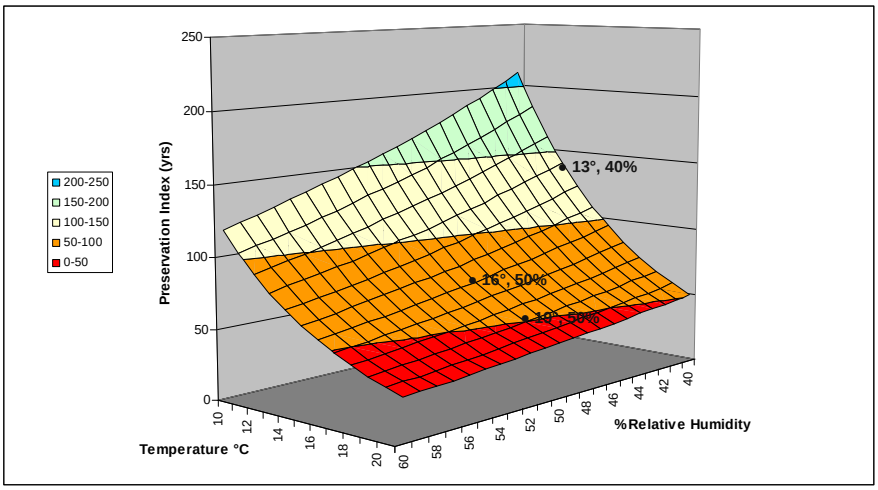
The Preservation Index



Just a quick word about the Preservation Index if you're not familiar with it. This is based on work done at the Image Permanence Institute on the rate of degradation of cellulose acetate microfilm, but this is actually very similar to the rate of degradation of cellulose, so it's commonly used to assess the suitability of library storage environments.

The Preservation Index is measured in years, which is nominally the time taken for a just noticeable change in appearance to occur. It is emphatically not the expected lifetime – it's better just to think of it as a guideline.

You can see from the graph that reducing both the temperature and the relative humidity has more effect than reducing them separately. I've marked 19°, 50% RH (the target conditions for the basements at St Pancras), 16°, 50% RH (the target for the Additional Storage Building) and 13°, 40% RH (the target fro the Newspaper Storage Building) to show the effects that reducing the temperature and relative humidity will have.

Energy and Digital Storage

- The BL's digital collections amount to nearly 100Tb now, expected to grow to 300Tb in 2013 and 2Pb in 2018
- The files are stored in 3 large server banks, at St Pancras, Boston Spa and the National Library of Wales
- The servers run 24/7 – they use energy to run and energy for cooling
- It is estimated that for every £1 spent on running servers, £1.20 is spent on cooling
- Is this sustainable?

Now a quick word about digital storage. You know that a lot of people think that the answer to all our problems is to digitise the whole collection, then we won't have to worry about preserving the physical items. You also know that this doesn't take any account of the obsolescence of file formats, hardware and software, and that digital preservation is at least as challenging and costly as physical preservation.

What is not often mentioned is the cost of keeping digital information available. A book sitting on a shelf consumes no energy and is ready to use as soon as it is requested. Digital information has to be kept on banks of servers, with hard disks that run 24/7. This uses a great deal of energy, and the amount used will continue to increase. What will happen in the future? Is this sustainable?

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Possible options

- Continuous Improvement – good housekeeping, file compression
- Idle servers – only spin up when required
- Move to Iceland – renewable carbon-free power, free cooling
- Technological breakthrough?

A lot can be done by clever design of the physical equipment, to keep the power consumption as low as possible, and to capture the heat produced for space heating. By good housekeeping and file compression we can minimise the space that each file occupies and maximise the number of files on each server. By collaborating with others we can make sure that no more copies of files are kept than is necessary to ensure their preservation.
A lot of effort is being put into idle servers that only spin up to full speed when required – this only takes a few milliseconds so the delay in accessing the files in minimal.

Iceland is also promoting itself as the ideal location for server banks. It has renewable, carbon-free power from geothermal electricity, it has free cooling. It is situated halfway between the US and Europe, and the government has invested in high-speed optical fibre links to both. Again, the delay in accessing files in Iceland is only a few milliseconds and is not noticeable to the user.

Finally, there is always the possibility of a technological breakthrough in high-density storage. Developments in the past ten years have meant that the storage capacity of the average home computer has expanded from megabytes to gigabytes, and this has made large servers possible. Flash memory technology, the sort of memory in a digital camera memory card, requires no power and can store large amounts of data in a small space. Just this week, Hewlett Packard has announced that it is commercialising memristor technology, which promises to pack even more data into a tiny package. See:
http://www.bbc.co.uk/news/technology-11165087

Finally, let me remind you that just over 100 years ago, it was predicted that because of the increase in horse-drawn traffic in London, in 1950 the capital would be 100 feet deep in horse dung! This didn't happen, because there was a technological revolution with the development of the internal combustion engine. Although we shouldn't put all our trust in this happening in the area of digital storage, it is always a possibility.