



Environmental Audits

Generic Report



1. The Environmental Audits Programme

During 2009 and 2010 sixty churches in the Cities of London and Westminster were inspected as part of the Two Cities Environmental Audits; five churches outside the Two Cities Area have since been added to the programme. This series of audits is part of the Diocese of London's response to the Church of England's Shrinking the Footprint campaign, which aims to reduce emissions by 20.12% by 2012 and 80% by the year 2050.

The purpose of the audits was to examine each church in detail, measure the church's carbon footprint as a result of energy and water use as well as waste and recycling, and then provide a list of actions that could be taken to reduce the church's carbon footprint in the short to medium term.

The data required for the audits was collected in several, complementary ways. First, a questionnaire was completed by each church's representative to provide information on the heating system, lighting system, building fabric and insulation, water use, waste and the use of the church by both the parish and other organisations. Utility bills and floor plans were also provided when the questionnaire was returned.

This information was then used to inform a detailed inspection of the church. The inspection allowed the collection of further information regarding the items examined in the questionnaire from both a visual inspection and an interview with the church's representative where possible. The questionnaire and inspection allowed a wealth of information to be gathered and this was used to produce a report showing the church's carbon footprint along with recommendations as to ways to reduce the footprint, including potential savings and costs.

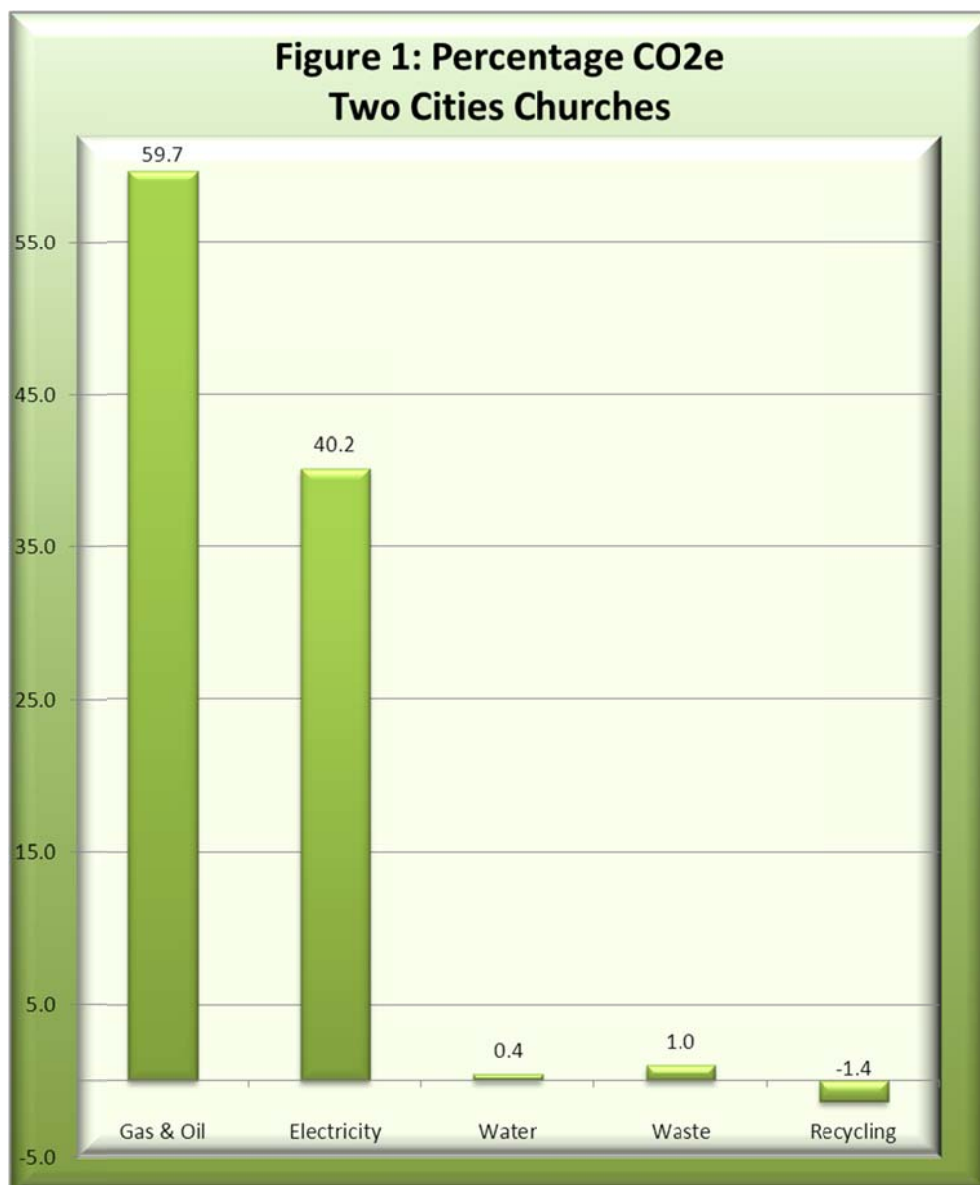
The results from, and the experience gained during, the audits have been used to inform and guide this Generic Report, which will allow Churches in the Diocese of London to take steps on their journey towards the goals of the Shrinking the Footprint campaign.

The report starts by looking at the sources of a church's carbon emissions and then examines the best strategy to go about addressing these emissions. Lastly the report details a variety of realistic interventions that can be made to actually reduce your emissions.

2. A Church's Energy Use & Carbon Emissions

2.1 Carbon Emissions by Type

The vast majority of a church's carbon emissions arise from the use of fossil fuels, such as gas and oil, for heating and the use of electricity for lighting. There are, however, also emissions from the use of water, the treatment of sewage, the production of waste and the recycling of waste. The relative percentages of each of these in respect of the churches inspected are shown in Figure 1.



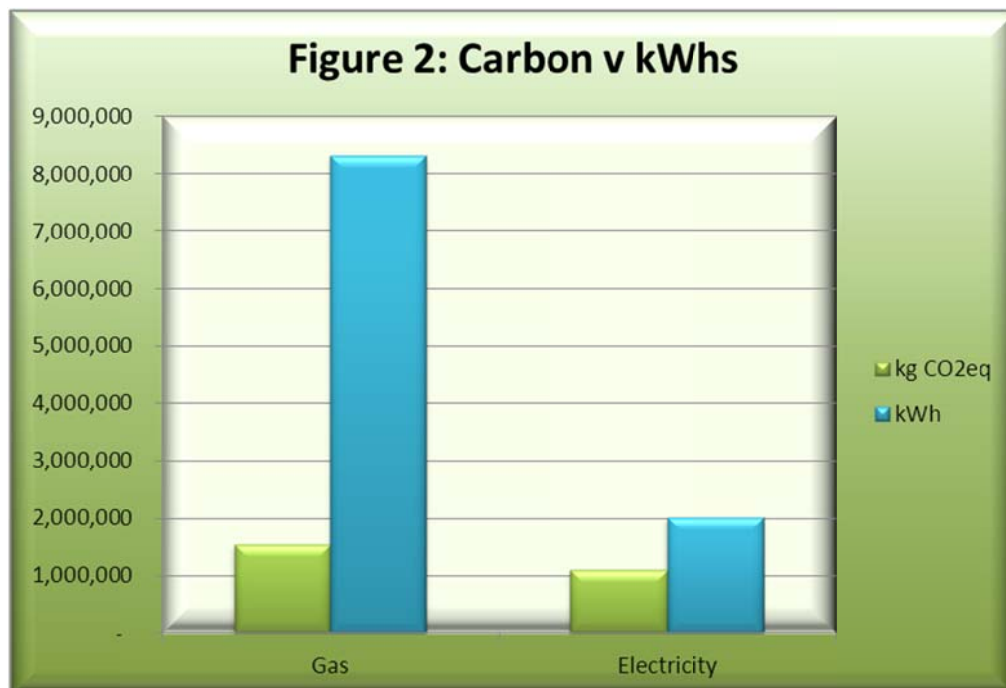
As can be seen the emissions caused by water, waste and recycling are very small relative to those from energy use, however it is important to note that recycling produces net *negative* emissions. In

addition, even though far fewer kilograms of waste were recycled (23,000kg) than were sent to landfill (110,000 kg) the negative emissions from the recycling significantly outweigh the positive emissions from landfill. This is because when materials, for example steel, are recycled less brand new steel has to be produced and this prevents the significant amounts of emissions that are created in the production cycle.

Despite this the emissions caused by the use of fossil fuels and electricity in the Two Cities churches are very much higher and these are the areas that your emissions reduction plan should aim to address first.

2.2 Carbon Emissions v Energy Use

It is also important to consider the relative amounts of carbon that can be saved by reducing electricity rather than gas. This can easily be seen in Figure 2 where the green columns show carbon and the blue columns show kWh. Due to the scale of the chart the green carbon columns for gas and electricity are not greatly dissimilar in size (as Figure 1 shows, emissions from gas are about 50% more than electricity) but to produce this amount of carbon far fewer kWh of electricity have to be used than for gas (the blue columns). This is because for every kWh of gas used 0.18 kg of CO₂eq is produced whereas for electricity the figure is 0.54 kg - which is **three** times as much!



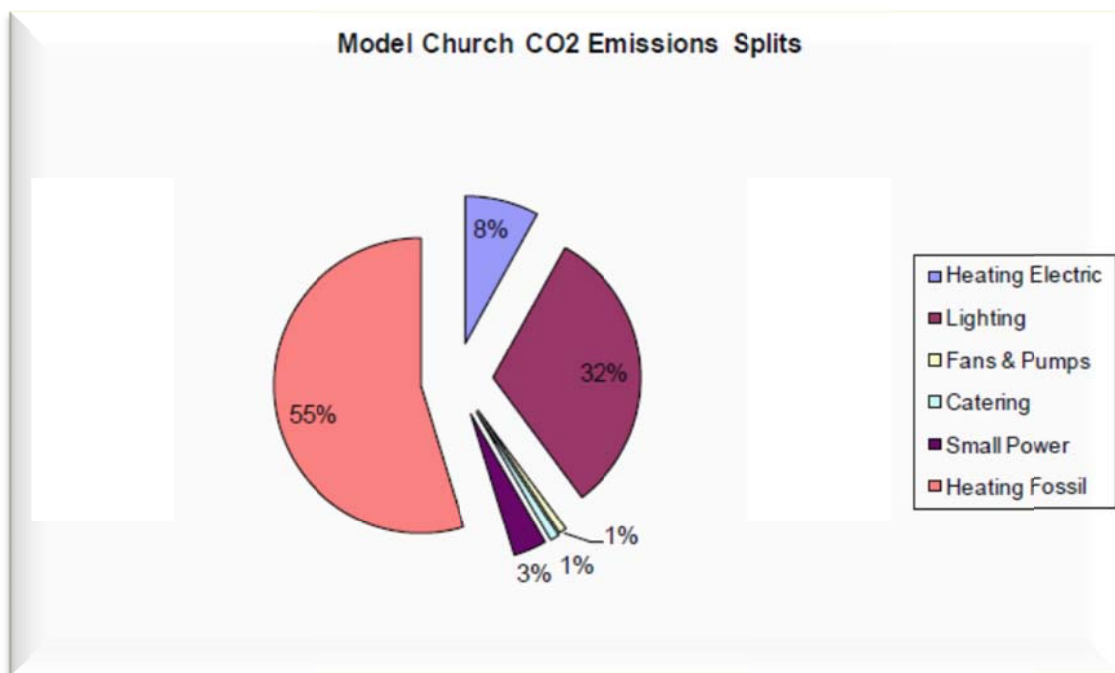
This means that saving a kWh of electricity produces a saving in carbon emissions **three times greater** than the equivalent saving from a reduction in gas use. Therefore reductions in electricity use should be prioritised. You should also remember that electricity costs around three times as much as gas.

2.32.3 How the Energy is Used

As part of the Diocese of London and Carbon Trust Generic Building Solutions project 20 churches were monitored in order to ascertain how and where fossil fuel and electricity is used in churches. Figure 3 (from the report prepared by Ove Arup & Partners in March 2011) shows the emissions from a Model Church. The left hand side of the pie chart represents fossil fuel use (55%) and the right hand side electricity use (45%). The figures from the Two Cities audit are 60% and 40% respectively, the difference between them being that few of the Two Cities churches had significant electrical heating, something that this church does have (the blue segment in the pie chart).

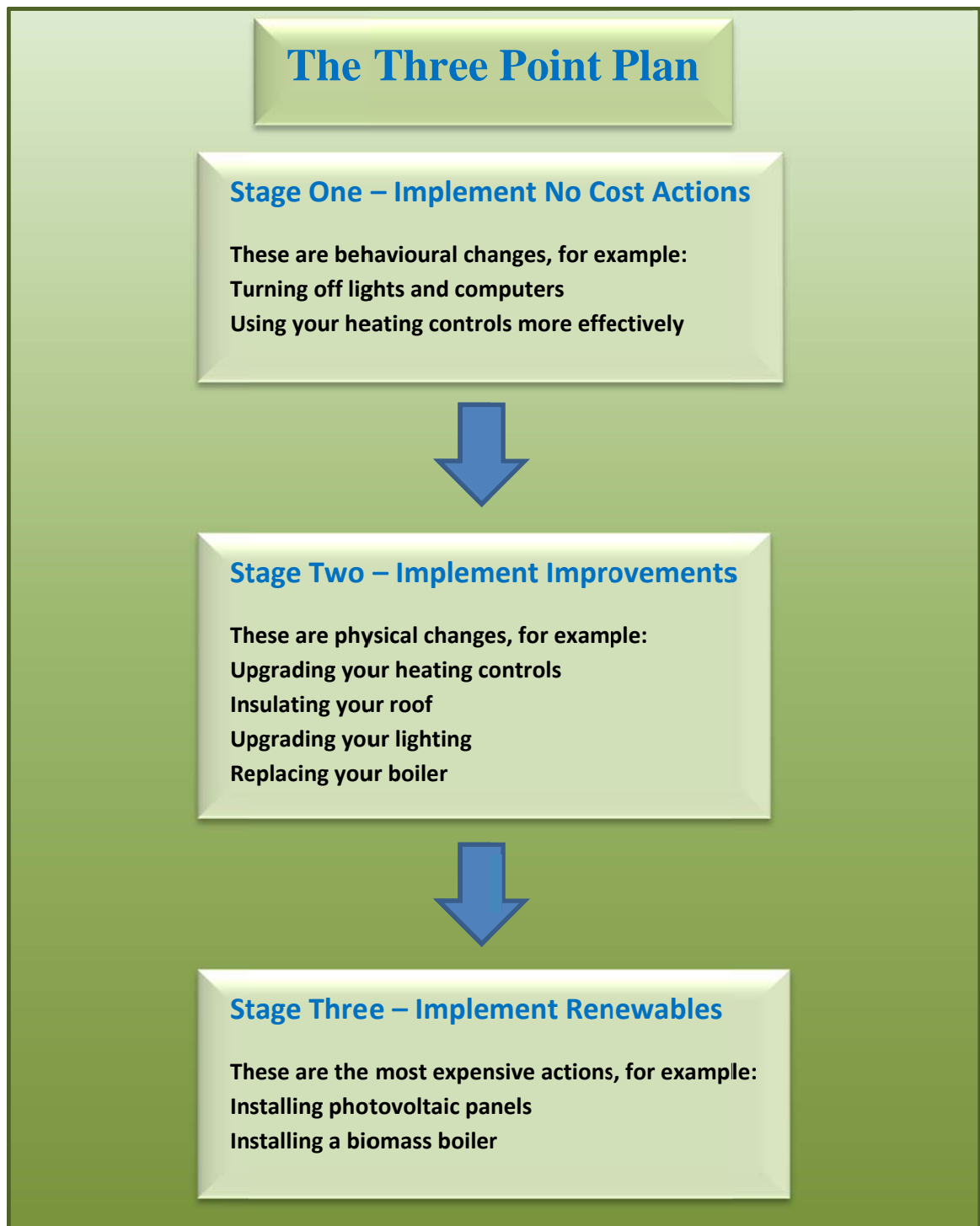
From the chart it can easily be seen that by far the two biggest energy users are heating and lighting – these are therefore the areas to concentrate on first.

Figure 3



3. The Three Point Plan to Reduce Your Carbon Emissions

When drawing up your emissions reduction plan the most important factor to consider is value for money – how can emissions be reduced as quickly as possible using the least amount of money? It is therefore important to use the Three Point Plan to ensure that you get value for money from your emissions reduction plan by targeting lower cost interventions first and only moving onto the more expensive options, such as renewables, later on.



4. How to Reduce Your Carbon Emissions

This section details some of the possible interventions that you could take to reduce your carbon emissions. They are divided up according to the three stages of the Three Point Plan and for each intervention is shown a possible reduction in carbon emissions, an annual cost saving and the cost of carrying out the intervention. The figures are based on data from, and calculations used, for the Two Cities Environmental Audits but you should note that as there is such a great diversity among the churches of the London Diocese these figures are indicative only. They do, however, give a picture of the types of actions that can be carried out and their relative costs and benefits.

Stage One – No Cost Actions				
Action	Possible % Reduction in CO2eq	Carbon Reduction kg CO2eq	Annual Cost Saving	Capital Cost (ex VAT)
Electricity - Only turn hot water heaters on when required, (or install timers). Keeping water hot when it is not needed wastes fuel	1.6%	688	£192	£0
Electricity - Turn off equipment not in use e.g. PCs, monitors, printers, photocopiers, PA systems and enable standby modes	1.6%	688	£192	£0
Lighting - Turn lights off in ancillary areas (such as corridors, stores and toilets) when these areas are not in use	0.3%	138	£38	£0
Lighting - Make sure that external "display" lights only come on at dusk and that they turn off no later than midnight	0.2%	69	£19	£0
Heating - Check that heating controls are set to only provide heat at the required times and make sure the clock is correctly set	9.1%	4,043	£792	£0
Heating - Try turning the thermostat down to a level where most of the congregation are comfortable. For each 1 degree reduction gas consumption can be reduced by 8%	4.9%	2,156	£422	£0

Stage Two – Improvements				
Action	Possible % Reduction in CO2eq	Carbon Reduction kg CO2eq	Annual Cost Saving	Capital Cost (ex VAT)
Lighting - Replace light bulbs/lamps with low energy equivalents	18.6%	8,254	£2,304	£3,000
Lighting - Fit occupancy sensors to infrequently used areas e.g. toilets, kitchens, stores and corridors	0.5%	206	£58	£400
Lighting - Investigate the feasibility of fitting daylight sensors to the main church. These sensors enable the lights to dim or turn off when natural light levels increase and to turn back on if it gets darker. If this is done the windows and skylights should be kept clean	2.3%	1,032	£288	£750
Heating - Repair broken windows. This will prevent warm air escaping but will also prevent cold draughts which can make it seem colder than it actually is	1.5%	674	£132	£750
Heating - Boiler - make sure regular servicing is carried out (at least annually). A boiler that has not been regularly serviced can use up to 9% more fuel than one which is serviced regularly. This also applies to other plant such as air handling units which contain filters which should be cleaned at least every six months	4.6%	2,021	£396	£400
Heating - Insulate the boiler or replace damaged/degraded insulation. This makes sure that the heat provided by the boiler goes into the heating system, rather than heating up the boiler room	4.3%	1,887	£370	£750
Heating - Insulate boiler pipe work & valves. This makes sure that the heat provided by the boiler goes into the heating system, rather than heating up the boiler room	4.6%	2,021	£396	£1,000
Heating - Upgrade the heating controls to include optimum start/stop and, where feasible, weather compensation. Optimum start/stop controls allow you to tell the system the time at which the building will be occupied - the controls will then learn how long it takes the building to heat up/cool down given certain internal and external temperatures and will turn the heating on accordingly. Weather compensation controls allow the system to react to changes in the external temperature - this gives the system more notice that the internal temperature is about to change, allowing it to react more quickly	3.0%	1,348	£264	£1,000

Stage Two – Improvements				
Action	Possible % Reduction in CO2eq	Carbon Reduction kg CO2eq	Annual Cost Saving	Capital Cost (ex VAT)
Heating - Investigate the feasibility of installing insulation to the roof. Adding insulation to a church roof can have damaging consequences - it should therefore be discussed with your architect first to make sure that the roof is suitable for insulation	6.1%	2,695	£528	£10,000
Heating - Investigate the feasibility of draught proofing all openable windows and doors. This will prevent warm air escaping but will also prevent cold draughts which can make it seem colder than it actually is. Please note that old buildings need ventilation so check with your architect to make sure this is a suitable measure	3.0%	1,348	£264	£1,000
Heating - When your existing boiler reaches the end of its useful life consider replacement with a modular boiler system with sequencing, optimum start/stop and weather compensation controls. If possible "zone" the heating so that areas with differing use patterns can be controlled separately and incorporate renewables where feasible. It is recommended that a Chartered Building Services Engineer with experience of churches and renewables is employed	18.2%	8,085	£1,584	£30,000
Heating - Change an oil burner to a gas fired burner. Gas costs less than oil per kWh but also produces 30% less CO2eq per kWh. This option can only be used where the burner is separate from the boiler	30.0%	8,085	£990	£8,500

Stage Three - Renewables				
Action	Possible % Reduction in CO2eq	Carbon Reduction kg CO2eq	Annual Cost Saving	Capital Cost (ex VAT)
Electricity - Investigate the feasibility of installing photovoltaic panels. This would produce an income via the Feed-in Tariff Scheme	5.3%	2,338	£653	£37,500
Heating - Investigate the feasibility of utilising waste heat from adjoining office buildings. This can be used to warm the air in the church or, via an air source heat pump, to provide hot water for heating or water	6.1%	2,695	£528	£10,000

5. Conclusions

The Diocese of London's response to the Church of England's Shrinking the Footprint campaign aims to reduce carbon emissions by 20.12% by 2012 and 80% by the year 2050. The data collected during the Environmental Audits and the Generic Building Solutions project suggest that the 2012 target is within reach while the 2050 target will require rather more planning and investment to achieve.

The studies carried out show that the vast majority of a church's emissions arise as a result of the burning of fossil fuels (mostly for heating) and the use of electricity (mostly for lighting). These are therefore the areas to concentrate on first.

When drawing up emission reduction plans it is important to get value for money by targeting those interventions that provide the largest reductions in emissions for the least capital cost. This can be done by following the Three Point Plan, concentrating on no-cost, behavioural actions first, physical improvements second and only looking at potential renewable applications when all else has been done to reduce the building's energy demand.

In this way the first steps can be taken towards attaining the goals of the Shrinking the Footprint campaign.