Cedar Chase Energy Review

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Version 0.4

1 Actual Energy Consumption

In early 2008 I asked how much gas and electricity people use per year. I got replies from 7 houses, showing a range of answers. Note that earlier versions of this document had some very large numbers for gas consumption: I have since discovered that some houses have newer gas meters which need a different conversion factor.

House	Heat hours per day	Gas kWh per year	Electricity kWh per year
1	5	12,000	3,500
2	15	12,400	5,200
7	15	20,000	10,800
9	10	12,000	5,000
14	7	25,000	6,200
18	6-14	15,500	3,900
24	9-16	15,700	3,900
Average		**16,100**	**5,600**

Some of the numbers were estimated from less than one year's data, but it is clear that there is wide variation. Some differences are due to whether people are out during the day or at home all the time, but there does not seem to be much connection between the heating hours figure and the gas consumption so there must be other factors at work.

I did not ask what the actual bills were which would have been a useful check, but based on the figures in the table above it is likely that next year each house will pay between £440 and £1200 for electricity, and between £300 and £1000 for gas.

2 Where does the heat go?

All of the gas and most of the electricity used becomes heat inside the house apart from a small amount that goes up the flue or down the drain with the bathwater. In the winter this all contributes to heating the house.

I measured all the external surfaces at number 2, and used published data to estimate how much heat we lose through each one. The details are in the spreadsheet in Appendix 1. I found that on a cold day (5C outside, 20C inside) we should need about 83kWh to heat the house for 15 hours – our normal daily schedule. I also measured the actual heating load over four cold days in January and found that we used 98kWh per day when the outside temperature was 5C.

This gave me some confidence in the calculations: the missing 15kWh could easily be lost to draughts and up the boiler flue.

The breakdown of the losses was roughly:

Lost through	**% of total heat loss**
Cavity wall (where bricks show outside)	21
Black wood on blockwork	19
Windows (plus draughts below)	14
Solid walls or minimal cavity (downstairs loo)	5
Roof	24
Floor	9
Draughts	9

Remember that this is all rather approximate. I have assumed that the gas heating is 90% efficient and that draughts make up the rest of the 'missing' heat.

Number 2 is a mid-terrace house so we have less wall exposed to the elements than some, and we have fairly good double glazing all round. The double glazing is important as it cuts down both the direct heat loss and the draughts. This could be one reason why we have such a low gas consumption.

Doing a similar calculation for an end-terrace house without double glazing gives this:

Lost through	**% of total heat loss**
Cavity wall (where bricks show outside)	19
Black wood on blockwork	12
Windows (plus draughts below)	14
Solid walls or minimal cavity (downstairs loo)	3
Roof	15
Floor	6
Draughts	31

I have assumed that single-glazed windows let in six times as much cold air as double-glazed. Even so, the figures do not account for the high gas consumption that some people have reported. To do that would require **ten times** as much cold air, accounting for almost 70% of the total heat loss!

3 What can we do about the heat loss?

Just looking at the energy consumption figures in the first section, it is obvious than many people could save a lot of money and help the environment at the same time. At number 2 we heat the house to 20C for 15 hours per day 7 days per week in the winter. Nobody has reported many more hours or a much greater temperature than this, so savings of up to 50% of the gas bill should be achievable without doing anything outlandish.

Even though number 2 seems to have one of the lowest gas consumptions on the estate, we still intend to reduce it further and a 50-60% saving looks possible.

Here is a list of things to think about, roughly in order of priority (the best value jobs come first).

3.1 Obvious things

Are you just burning money? Do you ever find the heating running when you have outside doors or windows open? Do you leave the pilot light burning through the summer? Do you heat every room even when nobody is in it? Do you leave the heating running when you go out? Simple changes to your own habits could save hundreds of pounds per year.

3.2 Draughts

This should be the first priority for most people. It is an easy and cheap thing to fix, and it produces an immediate improvement in comfort.

Look for gaps around doors and windows and fit draught excluders to block them. Wait for a windy day and feel the air-flow or hold up a single sheet of tissue paper to detect remaining draughts. Don't forget to check under the window-sills – this area is often very badly finished by builders. Check around the built-in cupboards and the loft-hatch if you have one. The larder in the kitchen has an air brick, but a few years ago we found that ours also had a massive hole into the cavity hidden by the door surround: this let in mice as well as draughts!

If you have bad draughts now you might save over 50% of your gas bill.

3.3 Servicing

The gas heating unit should be serviced every year. At the very least this makes sure that it is safe and that the air filter is not blocked. Most people use Mr Peat or Warm Air Services.

If the air-flow through the unit is restricted then most of the heat goes straight up the flue: you can tell because the wall gets hot near the top of the stairs.

3.4 Cavity walls

Consider cavity wall insulation. Your gas or electricity supplier will subsidise it and will send a reputable installer to quote. It should cost about £250, and save £50 - £100 per year from your gas bill. Pensioners and those on certain government benefits may be able to get this done free.

Modern systems should not suffer from the damp problems that appeared in the 1970s, and are guaranteed for at least 25 years.

Do make sure that the installers make good properly at the end of the job. The people who did ours got fairly close to the right mortar colour but were not very good at putting it in tidily, so we may end up re-pointing a few of the holes.

Make sure that the air-brick feeding the under-stairs cupboard is 'sleeved' so that it will not be blocked by insulation from the cavity. Do this *before* the installer's surveyor comes, or they will drill a big hole in your front wall and install an ugly new ventilator.

3.5 Windows

Consider double glazing if you do not already have it. These days you can have either wooden or uPVC frames.

It is extremely important that the new windows match the old ones. The width and position of glazing bars and the colour of the frames must be carefully specified. Please talk to the Cedar Chase committee if you plan to have new windows fitted.

Modern units should have multi-point locking (your insurance will insist on this) and built-in ventilators along the top.

Changing all the windows and doors from single-glazed to good quality double-glazed will save at least £50 a year. It may save considerably more if you currently suffer from draughts. This is a big job and it is worth getting the best units that you can find, as heat loss through windows is one of the largest factors in the cost of heating the house.

3.6 Loft

Cedar Chase houses have tiny lofts. Insulating them will help the small bedroom, but will not make a big dent in the overall gas consumption.

The energy companies will subsidise loft insulation, but the standard now requires 300mm of rockwool or fibreglass so there will be no storage space left if you do this. For another idea, see section 3.7 below .

3.7 Roof

The asbestos slates are starting to break up on many houses. They are already porous – look at the amount of moss that grows on the roof. Most people will be lucky to go another 10 years without some major roof repairs.

Why not consider replacing the roof *before* it starts leaking badly? It will be an expensive job, but it does give the opportunity to do a good job of the insulation across the whole roof.

Modern regulations require a thermal resistance better than $0.2W/m^2K$ [See Appendix: Units for an explanation of the units used in this paper]. This cannot be achieved with fibreglass or rockwool in the space we have available: the rafters are 175mm deep. We will need to get creative. There are very good foam board products now, but thickness is still an issue. One approach is to put some insulation between the rafters and another layer across the top: this provides a good air seal and can also link up with vertical insulation in the walls – see *Black timber* in section 3.8 below.

Some energy advisers suggest fitting roof insulation *inside* the house. This is undoubtedly cheaper than taking the tiles off, but it does have several problems. It reduces the ceiling height, which is already very low near the windows. It involves mess and disruption inside the house. It may give rise to damp problems in the roof structure unless extra ventilation is installed.

Bringing the roof insulation up to current standards will save about 90% of the heat lost through the roof. It will also make the houses much more comfortable in the heat of the summer. If all the insulation is in the structure of the roof then you will not need to insulate the loft space separately.

3.8 Black timber

The timber cladding has no cavity behind it. There is just a layer of bitumen felt and a block wall with plaster on the inside.

I do not know what type of blocks were used. They look like Thermalite, but may not be as good as that. If we assume Thermalite then the black-clad areas lose almost as much heat as the roof. If the blocks are less good then these areas might lose a lot more than the roof.

Another problem with these areas is that they let cold air into the house. There is a rolled steel joist above each of the big windows (or sliding doors) at the back, and there is nothing between this and the bitumen felt. The sealing around the edges is very poor, so lots of cold air can get in between the floor and ceiling.

One option here would be to put a layer of insulation board behind the black timber. It would need to be about 60mm thick to meet current regulations. Ideally this should be done at the same time as the roof so that the insulation boards can meet at the top (this avoids a 'cold bridge'). Careful design will be needed to make this look right and also to make sure that we do not create a condensation problem. These problems can be solved, but it is clearly worth thinking about the cladding and the roof together.

Another option is to put insulation boards on the inside of these areas. Most are obvious from inside as the wall sets back where there is black cladding. This would be easier than insulating under the black boards, but it would not be as effective.

3.9 Downstairs loo

This is the coldest and most uncomfortable room in most houses. It has a flat roof which may not have any insulation at all. There is no heating vent, and the whole room sticks out from the front of the house.

Our cavity wall installer claimed that there is no cavity but I think they are wrong. The cavity may be narrow, and it may not extend to the wall adjoining the next house's bin store.

Obviously it is worth getting insulation installed if you have to have the flat roof repaired.

If you cannot get the cavities insulated then you could consider an insulating layer on the inside. This has to be done carefully to avoid damp forming in the existing wall, but the insulation could be improved a lot if you could afford to lose 100mm of floor-space along each of the outer walls.

3.10 Floor

Quite a lot of heat is lost through the floor. In existing houses it is probably not worth the cost and upheaval to insulate floors, but if you do need floor repairs for any reason you should specify insulation to meet the Building Regulations requirements.

Thick carpets help.

3.11 Extensions

Houses 14 and 18 have ground-floor extensions with flat roofs. The main extra loss here is due to the flat roof itself and to the windows in the rear wall. Next time the roof needs work it would be worth insulating it to current standards (indeed this may be a legal requirement).

4 Electricity

The houses in the survey reported annual consumption in the range 3500 to 10800 kWh. The ways in which people use electricity are much more varied than the ways they use gas, so the scope for savings is more difficult to estimate.

I have some power measuring devices that work with anything that uses a 13A plug. This allowed me to get accurate figures for most of the large items at number 2. For lights and other wired-in appliances I found the rated power of each in Watts and multiplied it by the number of hours that we use the appliance. As a check on my estimates I worked out the annual consumption of everything and compared it with our actual electricity bills. The result was within 10% - much closer than I had expected!

The major items were:

Appliance	**kWh/day**	**kWh/year**	**cost/year**
Fridge/Freezer	2.2	802	£71
Dishwasher	0.54	196	£8
Washing machine	0.37	133	£6
Towel rail	0.48	175	£12
Immersion heater	5.8	2117	£90
Outside light	0.12	44	£3
Security lighting	0.5	183	£20
Hall lights	0.8	292	£32
Kitchen lights	0.4	146	£16
Living room lights	0.6	219	£24
Bedroom lights	0.15	55	£6
Dining room lights	0.3	110	£12
Cloakroom heater	0.63	230	£10
Office computers etc	2.24	816	£71
TOTAL	**15**	**5563**	**£380**

The numbers are rounded, and the cost calculation is complicated by the fact that we have the Economy-7 tariff and use time-clocks to run things like the immersion heater overnight.

Our main electricity costs divide about equally between the office, water heating, refrigeration, and lights. In fact we have already reduced some of these – see below.

5 Reducing electricity consumption

Try to work out where most of your power goes and tackle the big items first.

5.1 Water heating

As Cedar Chase has hot-air heating, most houses heat all their domestic hot water using electricity. This can be quite expensive. One unit of electricity will heat about 20 litres of water from mains temperature to 50C.

Some obvious things to do: Make sure the hot-water tank insulation is good. Fix dripping taps. Don't leave hot taps running while washing up (this costs a fortune). Use showers rather than baths. Use dishwashers and washing machines rather than hand-washing where possible (strange, but true: you get much more done in one load using less hot water by using a machine).

Showers normally use much less hot water than baths, but power showers can use a lot more. If you have a power shower you may be able to fit a shower head that uses a bit less water, but the main saving comes from having *short* showers!

Switching to gas or solar water heating may be good in the long term, but is expensive to do.

If you have to replace your warm air heater, try to get one that also heats water and get it coupled up to the hot water tank.

5.2 Space heating

Electric heaters are *much* more expensive per unit of heat than the gas central heating is, so use gas to heat the house. The current costs are something like this:

Heat source	Cost per kWh
Gas	3p
Economy-7 night-time electricity	5p
Economy-7 day-time electricity	13p
Single-rate electricity	11p

5.3 Refrigeration

Fridges and freezers use a surprising amount of electricity. Our old fridge-freezer was costing about £71 per year to run. Replacing it with a pair of A++ rated appliances has saved about 615 kWh per year – about £56 every year, which is a good return on the investment.

5.4 Dishwashers and washing machines

New ones should be more efficient than old ones. Look for the energy rating labels. Perhaps you could run the machines less often if they were larger – worth considering.

The main thing here is to make sure you only run the machines when you have a full load.

5.5 Lighting

There is a good range of low-energy lighting available these days. Newer bulbs will fit into most existing fittings, and they often give more light than the old incandescent bulbs.

Incandescent bulbs of 60W and below are particularly inefficient, so replace those first.

Obvious things: turn off the lights when you leave an empty room.

5.6 Computers

Laptops use less power than desktop or tower computers. TV-type screens get hot so they obviously use a lot of power – even if they are apparently turned off in some cases.

Many computers have a sleep mode that reduces the power consumption when you are not using them but allows them to restart quickly. This helps, but only if you use it!

Some printers use as much electricity when 'turned off' as they do when on! Always turn them off at the wall.

5.7 TVs

I nearly forgot this as we don't have one. TVs can use a lot of power – particularly the old ones, but even some of the newer flat-panel types are thirsty. Plasma screens in particular cost a lot to run: you can tell because they get hot or they have fans to keep them cool.

Many TVs and similar devices use power even when apparently turned off. The answer is to turn them off at the wall.

6 CO_2

The news is full of Climate Change and Carbon Footprints these days, so where do we fit?

The sums are quite easy for gas: 1kWh of gas heat produces 0.206kg of CO_2 so the average Cedar Chase house is responsible for about 3.3 Tonnes of CO_2 per year for heating. Heavy users of gas could be generating 7 Tonnes per year!

Electricity is a bit more complex as it depends on the 'energy mix'. Coal burning power stations produce a lot of CO_2 per kWh, hydro and nuclear produce almost none. Wind farms are complex to analyse because of the need to provide alternative supplies when the wind is not strong enough. Using government figures for the UK as a whole, electricity generation produces 0.52kg of CO_2 per kWh so the average Cedar Chase house is responsible for about 2.9 Tonnes per year for power. Just to add to the fun, if you *save* a unit of electricity you only save 0.43kg of CO_2 – this is because of the type of generator that gets turned off when the demand goes down.

7 Renewables

What about solar, wind, CHP and all that lot? Here is a very quick canter through some options:

7.1 Solar water heating

This is one of the best options for Cedar Chase. Every house has one roof surface facing south, which helps a lot.

A typical installation would be 2 – 3 m^2 of collector area with a new hot-water tank, pump, and control box. Manufacturers suggest that this will deliver 800 – 1200 kWh per year. The saving from this depends on your electricity tariff: about £40 for Economy-7 and about £100 for a single-rate tariff. Having the system installed costs around £3000 so the payback time is at least 30 years at current energy prices (maybe longer than the life of the system). An equivalent DIY kit would probably cost at least £1000: even there you would probably do better to just switch to Economy-7 and buy a time-clock! Also remember that the pump needs power, so the heat is still not completely free...

The best supplier that I have found so far is “Solar Savings”: http://www.solarsavings.co.uk/

7.2 Solar heating

Non-starter. You need heat in the winter. Winter is cold because there is not much solar heat around.

7.3 Solar electricity

Still very expensive. None of the existing systems will pay for itself within its working lifetime. This will change as new technology becomes available. A lot of research is being done in this area, so the situation could be very different in 10 years.

7.4 Wind power

You can get small wind turbines for a few thousand pounds. They are not very effective though, and there are few places on Cedar Chase where they would ever generate usable electricity. Even in wide open spaces some of these machines never generate as much power as it took to make them!

Industrial-scale wind farms are a different matter. They really do generate useful power. How much carbon they save is still under debate, as other sources of power are needed to cover the days with no wind. One of the big problems is that most winters have at least one period of several days when there is no usable wind anywhere in Europe!

7.5 Biomass

You can burn wood or straw to heat the house. Very traditional, and I like open fires. Of course Cedar Chase does not have fireplaces and the traditional ones are very inefficient anyway. Modern biomass systems tend to use wood chips delivered in 20-tonne lorries. A few schools and public buildings are starting to use this, but it is not likely to help us in the near future.

7.6 CHP - Combined Heat and Power

The idea here is to generate electricity using diesel or gas, and to use the waste heat from the engine to heat the house. There are some small systems on the market, but the economics are not clear for domestic installations yet. Offices and factories can benefit though.

7.7 Heat pumps

A machine rather like a large refrigerator can extract heat from the ground or a river and pump it into the house. The very latest type runs on gas or diesel and gives you the waste heat from the engine too.

These have been around for a long time (the Festival Hall was originally heated using heat pumps taking heat from the Thames). The smaller ones have not been very reliable historically, but if the market grows this will probably improve. Worth watching, but expensive to install in an existing house.

8 Replacing the hot-air units

The original Lennox hot-air units are now over 40 years old. Some have been replaced already, but it is not easy getting direct replacements. I have seen comments on the Internet suggesting that the original units are 78% efficient at best. Modern condensing boilers should be 95% or more. There do not appear to be any condensing hot-air units on the market at all so it is likely that replacements are not much more efficient than the original equipment.

8.1 Direct replacement

One supplier of replacement heaters and accessories (grilles, registers, diffusers etc) is Johnson & Starley: http://www.johnsonandstarleyltd.co.uk/ I cannot find any prices for the heater units, but there is a wide range available. Some can be fitted with water heaters, which would be well worth considering. The website does claim that the units are compliant with Part L of the Building Regulations, so the efficiency cannot be too bad.

8.2 Alternative idea

Here is a radical alternative:

We could take out the hot-air unit and install a modern condensing boiler with a separate water-to-air heat exchanger. The boiler could also heat the domestic hot water.

This is not something that the average plumber is going to think of. Heat exchangers are common in commercial buildings, but very rare in houses.

My current thought is that the boiler could go high up above the bathroom window, with a balanced flue through the front wall (one house has already done this for other reasons). There is a viable pipe route from there to the under-stairs cupboard, where the heat exchanger would be fitted. It would also be possible to take pipes across at a high level to the airing cupboard to feed the tank. If doing that, I would also bring back a direct feed for a power-shower with the pump in the airing cupboard. This would also be the right time to consider solar water heating, but the use of gas heat makes it even less attractive financially!

The main difficulty is to get a suitable fan / heat-exchanger combination to match up with the heating ducts. I have not started looking into that yet, though Johnson & Starley do have a unit that they call *Aquair* which is rated at 8kW when fed with water at 80C.

Removing the gas heater from the under-stairs cupboard might also allow us to close or restrict the air-brick there, further reducing winter draughts. That air brick *must not* be restricted in any way while there is still a gas-burning appliance in the cupboard.

9 Cedar Chase Heat Loss Estimates

This spreadsheet can be used to estimate the heat loss of Cedar Chase houses and to show how much could be saved by improved insulation. Remember that all the numbers are estimates so the answers may not be very accurate.

The printed version shows the calculation for number 2: a middle-terrace house with double glazing all round.

You will find a downloadable copy of the spreadsheet on the Cedar Chase website: http://www.cedar-chase.org.uk/

9.1 Using the spreadsheet

The light orange boxes are the main inputs that you need to change to match your house:

- Set the *End Terrace* box to 1 if the house is an end-terrace, or to 0 if it is not.
- Set the *Double Glazed Windows* value to 0 if you have original single-glazed windows. Set it to 1 if you have all-round double glazing. If you have a mixture, set this to a suitable fraction between 0 and 1.
- Fill in your approximate yearly gas bill. This is used to estimate the financial savings available from better insulation.
- Houses 14 and 18 should set *Side Extension* to 1. Everyone else should set it to 0.
- Fill in your room thermostat setting in Celsius. Most people find that 20 – 22 C is comfortable for sitting and reading.
- Fill in the number of hours per day that you run the heating.
- The figures for draught loss are very difficult to estimate. One way is to measure your actual energy consumption on a cold winter day and then adjust the draught figure until the estimated consumption matches what you measured.

You can now read the results. Start with the *Cost saving on gas* column: this gives an estimate of what you might save by upgrading your insulation. At number 2, our gas bill is about £600 per year and the spreadsheet suggests that we could save about £420 of this if we upgraded everything. Some items save a lot more than others, so we can use the individual figures in this column to set priorities.

The figures in the blue box indicate the amount of power required to heat the house for different outside temperatures, and show how much energy this uses per day.

Type	Area m^2	U-value now W/m^2K	U-value with achievable insulation W/m^2K	Loss per K W	Loss per K with insulation W	Saving per K W	Cost saving on gas (£/year)	Building regs U-value required W/m^2K
Cavity wall (most brickwork)	52	1.6	0.5	83.2	26.0	57.2	73.5	0.3
Black wood on blockwork	30	2.5	0.3	75.0	9.0	66.0	84.9	0.3
Windows	20	2.8	1.8	56.0	36.0	20.0	25.7	1.8
Solid walls (downstairs loo?)	8	2.5	0.5	20.0	4.0	16.0	20.6	0.3
Roof	48	2	0.2	96.0	9.6	86.4	111.1	0.2 or 0.16
Floor	48	0.76	0.76	36.5	36.5	0.0	0.0	0.22
Extension roof	0	3	0.2	0.0	0.0	0.0	0.0	0.2
Draughts (big guess)				100.0	40.0	60.0	77.1	
			TOTAL	**466.7**	**121.1**	**305.6**	**392.9**	

End Terrace?	0	Heat load 10C outside (W):	5600.2	1453.0	4147.2
Double glazed windows?	1	kWH/day	84.0	21.8	62.2
Gas bill per year	600				
Side extension (#14, #18)	0	Heat load 5C outside (W):	7933.6	2058.4	5875.2
Thermostat setting (C)	22	kWH/day	119.0	30.9	88.1
Heat hours per day	15	Kg CO2	24.51	6.36	18.15

The loss due to air infiltration (draughts) is guesswork – this can be a big cost
All U values are estimates from published data

Actual energy consumption for number 2 measured in late Jan 2008: 98kWh/day at 5C outside temp.
Savings assume that the entire house is heated to the same temperature

If existing windows are double-glazed we assume U=2.8. With the best modern PVC or wooden framed windows we might achieve U=1.6
Original Cedar Chase windows probably have a U value around 4.3

Floor U value calculation	House	Loo/lobby	Combined
Exposed floor perimeter (m)	22	6	28
Floor area (m2)	48	4	52
Floor U value	0.68	1.18	0.76

Kg CO2 per KWh gas	0.21
Yearly cost per W per K	1.29

10 Electricity Consumption at 2 Cedar Chase

Electricity consumption April 2008

2 Cedar Chase

Day rate (p/kWh)	10.83
Night rate (p/kWh)	4.24

		dec 05 – nov 06	mar 07 – mar 08
Actual consumption	day	2943	2620
	night	2285	2674
	Total	5228	5294

	kwH/day	dayrate hrs	nightrate hrs	total hrs	cost/day (p)	cost/year (£)	kwH/year
Fridge (A++, new Oct 2007)	0.16	17	7	24	1.44	5.24	59
Freezer (A++, new Oct 2007)	0.35	17	7	24	3.12	11.38	128
Dishwasher	0.54	0	7	7	2.27	8.29	196
Washing Machine (new April 2008)	0.2	0	2	2	0.85	3.10	73
Towel Rail	0.48	2	3	5	3.30	12.05	175
Water heating	5.8	0	7	7	24.60	89.80	2117
Outside light	0.12	5	7	12	0.84	3.06	44
Security lighting	0.5	5	0	5	5.41	19.76	183
Hall lights	0.8	4	0	4	8.66	31.61	292
Kitchen lights	0.4	2	0	2	4.33	15.81	146
Living room lights	0.6	2	0	2	6.50	23.71	219
Bedroom lights	0.15	1.5	0	1.5	1.62	5.93	55
Dining room light	0.3	2	0	2	3.25	11.85	110
Cloakroom heater	0.63	0	7	7	2.67	9.75	230
Office lights	0.36	5	0	5	3.87	14.11	130
Laptop	0.48	17	7	24	4.27	15.60	175
Laptop	0.48	17	7	24	4.27	15.60	175
Server	0.32	1	4	5	1.78	6.49	117
Routers and phones	0.6	17	7	24	5.34	19.50	219
TOTALS	**13.26**				**88.40**	**322.65**	**4841**
Office total	2.24						
Office total (measured)	1.9	17	7	24	16.91	61.71	693
Old Bejam Fridge/freezer	2.2	17	7	24	19.57	71.42	802
Old Washing Machine	0.37	0	2	2	1.55	5.66	133
Kg CO2 per KWh elec	0.52					Kg CO2/yr	2532.06
Kg CO2 reduced per KWh elec saved	0.43						

Appendix: Units

Temperature: C (Celsius) or K (Kelvin). Both units are the same size but Kelvin is used for most scientific work as it is the absolute temperature scale.

0C = 273K

10C = 283K

100C = 373K

Power: W (Watt) One Watt is about the power of a torch bulb so for heating we talk about kilowatts (kW).

1kW = 1000 Watts.

Energy: kWh (kilowatt hours). One kilowatt hour is the energy used by running a single-bar electric fire for an hour. The scientific unit is the Joule (J) which is one watt for one second.

1kWh = 3,600,000J

Thermal conductivity: W/m^2K This measures how much heat is lost per square metre of wall or roof for each 1K (1C) of temperature difference. For example, Cedar Chase houses have about 48 square metres of roof so if the thermal conductivity is 2 W/m^2K the roof will lose 96W for a 1C difference. In the winter with the outside temperature at 5C and inside at 20C this means that the roof alone is losing 1440W or 1.4kW.