Energy Money Saver

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how we saved over £2,000

by

Sam Cooke

Energy Money Saver – how we saved over £2,000

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First published on Amazon, August 2023, this version: 11th November 2023

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Non-fiction by Sam Cooke

Twenty Years a Stranger – *Monster in the house*

Energy Money Saver

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Introduction

Over £2,250 saved

In 2022, energy prices went mad, hitting our households and industries with the worst energy hardships in decades. While the fossil-fuel companies have raked in £billions, were does that leave us? Destined to be powerless or can we reduce the expenses enough to avoid financial Dark Ages?

There is a huge amount of bad and biased energy advice out there. In response, this book has been written to show how money can really be saved. No hidden agenda or sponsorship for particular products or energy sources. A pure focus on discovering the truth and sharing it with you.

Although the devices tested will be different models to yours, similar devices have similar characteristics, so what reduces energy consumption on ours will make a similar reduction on yours. If you have a bigger TV, more powerful computer and other devices, the money saved can be even greater.

This book is split into three sections.

Section One: electricity.

Section two: gas.

Section three: energy production.

> Box-outs like this give extra information and a glossary of technical terms can be found at the back.

All temperature measurements are in degrees centigrade (C). Cost calculations are based on a unit price of 50p per kWh for electricity and 20p per kWh for gas. Savings are added up, chapter by chapter.

Electricity

Chapter 1

Standby Energy

Savings in this chapter: £121.33

Standby energy, the electricity used when a device is plugged in but turned off, is money quite literally thrown away. Below is a list of devices and their standby energy usages.

Device	Standby	Cost year
Computer one with one monitor	3.1W	£13.58
Computer two with two monitors	4.5W	£19.66
Computer three with two monitors	5.2W	£22.78
40” LED TV	0.5W	£2.19
32” LED TV	0.5W	£2.19
Clock radio (clock only)	1.3W	£5.69
Laptop 1 - plugged in, charged, off (Charger only only on mains socket)	0.5W (0.8W)	£2.19 (£3.50)
Laptop 2 - plugged in, charged, off (Charger only on mains socket)	1.3W (0.9W)	£5.69 (£3.94)
Music system, off at own switch	0.6W	£2.63
Washing machine 8kg 14,000rpm	0.6W	£2.63
Wi-Fi router (on but no data usage)	5W	£21.19
DVD player	0.6W	£2.63
Coffee grinder	0.8W	£3.50
Ni-Mh battery charger	1.2W	£5.26
Night light, 0.5W	0.5W	£2.19
Freesat box	0.5W	£2.19
Freesat box with recorder	1.3W	£5.69

Electric cool/hotbox	0.9W	£3.94
Under cupboard LED strip light	0.7W	£3.07
Total	**29.6W**	**£129.65**

The standby energy of 29.6W doesn't sound like much but that is 29.6W, 24 hours a day, 7 days a week, 52 weeks a year. Over a year it adds up to 259 kWh and £129.65. Basically, £130 of my money and 259 kWh of electricity is being used for absolutely nothing. If the 27.8 million households in the UK are averaging the same that equates to £360 million and 720 MWh of electricity, being lost for absolutely nothing, every single year.

All these devices are now turned off at the plug or unplugged, except one - the Freesat recorder, in order to be able to recorded scheduled programmes. The 1.3W standby power needed to do this reduces the standby savings from 29.6 to 28.3W, still saving £123.95 a year.

Devices that naturally use totally zero include the vacuum cleaner, toaster, display=free air-fryer, display-free oven, non-dimming light bulbs and bathroom fan - anything that physically 'hard' switches off, as opposed to electrically 'soft' switching 'off'. If you can turn a device on with a remote control it is 'soft' switched off. If in doubt, why not just turn a device off at the plug or extension lead?

Smart Meters are not smart. Their original concept potentially was, as originally they were planned to do far more than just display total consumption. While they give a live readout of total energy usage, few tell you how much energy is used per device. Each 'smart' meter device uses around 5W of energy to run - adding up to 43.8 kWh, £22, a year. For what? Once you know how much a device uses and how to minimise the consumption, there is no need for a constant read-out of what is already known.

Star Tips Worth: £125

If it has a screen or a silicon chip, turn it off at the plug.
Sounds obvious but so easy to forget.

Chapter 2

Energy Labels Explained

Savings so far: £121.33

Savings in this chapter: £N/A

Energy labels are designed to rate the energy efficiency of goods, from A (best) to G (worst). However, over recent years there has been a vanishing of A-rated white goods and times when two identical products, even by the same manufacturer, can be found with completely different energy ratings. Why?

The European energy label system was launched some 25 years ago, to give consumers a clearer picture of what product is more energy efficient than another. Since the launch technology has moved on, a lot. Traditional tungsten light bulbs wasted 95% of the energy as heat. Halogen filled bulbs came along and were better but still wasted most energy as heat. Along came fluorescent bulbs, which wasted far less energy. Now we have LED bulbs, even more efficient than fluorescents and the polar opposite of tungsten bulbs, turning 95% of the energy into light, not heat.

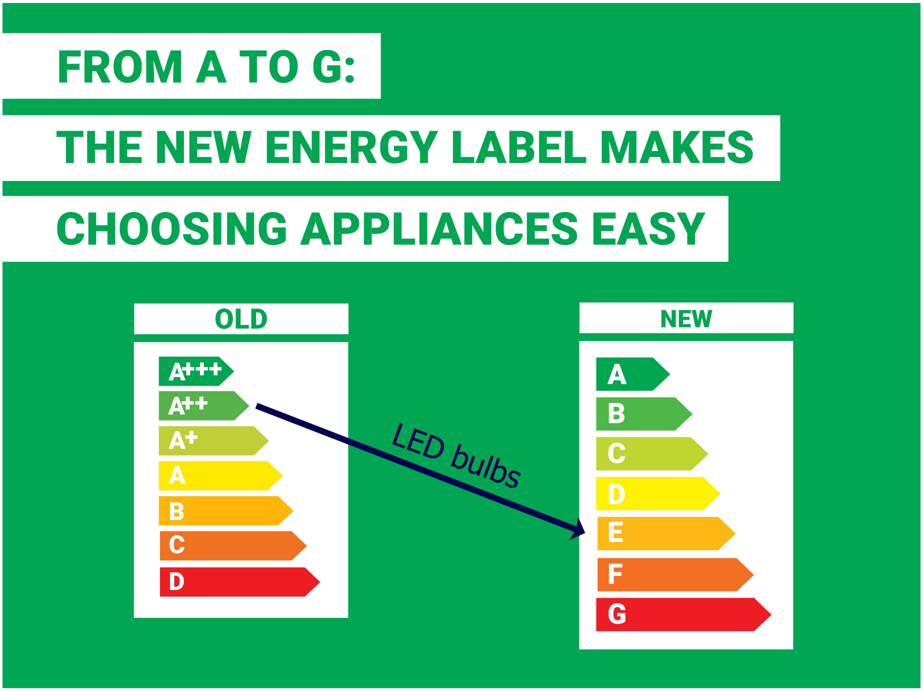
Originally LED bulbs were rated A+ or even A++ but LED technology does not stand still - better and more efficient LEDs are still being developed. To help encourage further development, the labelling system was updated to give ratings the chance to 'grow'. No longer top of the tree at A+/A++, LEDs have been dropped to E or even F. In the same way white goods previously rated A have been dropped to E. Products wanting to climb back up the label tree will need to become even better.

What we have now is the transition-period. Identical items, side by side on the same shelves, some labelled with the old system and some with the new, depending on the labelling date. If the energy scale starts with 'A+++' it is the old system, if it starts with 'A' it is the new, as shown in the diagram on the next page.

What hasn't changed is the value of the numbers. A 3.2W LED bulb will always use around 3.2W, regardless of the energy label given.

Energy labels - old and new

Image modified, original copyright energylabel.org



LABEL 2020

In the above illustration, I've added the example of LED bulbs to show how the same items have different ratings on the new labelling system. In the same way our previously A-rated fridge-freezer would now be E rated.

More details can be found at **www.energylabel.org**

Chapter 3

Kettles

Savings so far: £124

New savings in this chapter: £76

Boris Johnson's 2022 energy-crisis advice was: *“..spend 20 quid on a new kettle and save £10 a year...”* Interesting advice, considering doing so would take two years just to break even. Out of curiosity a brand new kettle was bought for testing, to measure how it compared with an old one.

Cost calculations: are based on a kettle being used five times a day, every day; totalling 1825 times a year. Your own usage may be higher or lower but this gives a reasonable usage number for usage cost comparisons.

1) Russel Hobbs 23602, 3kW, 1.7 litre

This kettle is five-years-old. It has always been used with filtered tap water so has minimal limescale.

Test One: Full Boil Cost

The tests were done with various amounts of water, to find out how much energy it takes this kettle to boil the water and turn itself off. The kettle was allowed to fully cool between tests.

Water (litres)	**kWh**	**Cost**	**Cost per litre**	**Cost per year**
0.5	0.058	2.9p	5.8p	£52.92
1.0	0.103	5.15p	5.15p	£93.99
1.7 (max)	0.162	8.1p	4.76p	£147.83

SAVED £53.84, by boiling a litre of water, not a full kettle, and using it to make three cups of tea each time. Although it is cheaper per litre to boil a full kettle heating unnecessary water would be a waste.

Water amount: If you have a water level marker on you kettle, empty it then pour in cold water from the cups/mugs you regularly make a hot drink in, plus a touch more to allow for evaporation. Look at where the water comes to on the marker. Now you know the amount of water you need for your regular drinks and will only be heating as much as you actually need.

Caution: if you have a kettle with an exposed heating element (something that looks like a crazy straw) always use enough water to cover it. If you don't, the uncovered section can get extra hot and shorten the life of the element.

Fizzing: in every case, we wait for our kettle to stop most of its 'fizzing' before pouring – the 'fizzing' is from the still hot element still boiling the water and pouring the water while it is fizzing lets the element boil dry – which can shorten its life and encourage the build up of limescale.

Flask: **i**f you just make one drink every few hours, rather than boiling water for one, you could boil water for two and put the rest in a flask for later.

Test Two: Speed of Temperature Lost

The temperature of a boiled kettle drops over time but how quickly? With the kettle filled to 1.7 litres and boiled to auto turn off, the kettle was left to sit, lid on, for 3 minutes (180 seconds); during which time the temperature was recorded at 30 second intervals.

Temp:	**100**	**96.1**	**92.2**	**89.1**	**86.1**	**84.8**	**83.0**
Time:	0	30	60s	90s	120s	150s	180s
Temp Loss:	N/A		7.8/min		6.1/min		3.1/min

The hotter the water is the faster it loses heat. From 100 degrees it lost 7.8 degrees in the following minute. From 86 degrees it lost just 3.1 degrees in the following minute. If you want fully boiling water, you need to use it quickly. If you don't need fully boiling water why fully boil it in the first place? Why not just partially boil it, to the temperature you do need, use it promptly and avoid the extra cost of heating it more? This leads us to test three.

Test Three: Partial boil savings?

The plan was to heat one litre of water using 70%, 80% and 90% of the 100% fully boiled energy of 0.103 kWh. The relative energy figures were calculated as 0.0721 kWh, 0.0824 kWh and 0.0927 kWh respectively.

Energy	**100%**	**90%**	**80%**	**70%**
Cost per boil *(saving)*	5.15p *(0)*	4.64p *(0.51p)*	**4.12p *(1.03p)***	3.61p *(1.54)*
Saving per year	£0	£9.31	**£18.80**	£28.11
Temp	100	95.4	**87.9**	77.1

SAVED £18.80 by turning ours off after 80% energy has been used. The water still gets to 88 degrees and, by using the water within seconds of heating, it is still above 85 degrees when poured - plenty hot enough for tea and coffee.

80% Energy Timings

If you don't have an energy meter, how to work out when your kettle has used 80% of the energy need to boil? Time how long it takes to fully boil your regular amount of water and use the conversion table below - or convert the time to seconds and multiply it by 0.8. The result will be how many seconds it takes to get to 80% energy usage.

After doing this a few times you will recognise the sound the kettle makes at 80%, without needing to use a timer.

Timing Conversion Table - 100% to 80%

Full boil energy (100.00%)	**Partial boil energy (80%)**	**Full boil energy (100.00%)**	**Partial boil energy (80%)**
1 min (60s)	48s	3.5 min (210s)	2 mins 48s(168s)
1.5 min (90s)	1 min 12s (72s)	4 min (240s)	3 mins 12s (192s)

2 min (120s)	1 min 36s (96s)	4.5 min (270s)	3 mins 36s (216s)
2.5 min (150s)	2 mins (120s)	5 min (300s)	4 mins (240s)
3 min (180s)	2 mins 24s (144s)	5.5 min (330s)	4 mins 24s (264s)

2) Tesco TBJK20, 2kW (1850-2200W), 1.7 litre

And now for the new kettle and the question of Boris Johnson's advice: *“..spend 20 quid on a new kettle and save £10 a year...”* Following this and advice from those who say *“lower energy devices save money”*, a brand new kettle, with a 33% lower power rating of 2kW, was bought. How much money would the brand new 2kW kettle save us compared to the 5-year-old 3kW one?

Boil to 100 degrees	**2kW new kettle**	**3kW old kettle**
1 litre (saving per year)	0.107 kWh (£-3.65)	0.103 kWh (£3.65)
1.7 litres (saving per year)	0.169 kWh (£-6.39)	0.162 kWh (£6.39)

According to the tests, both Boris and the 'experts' are wrong. The brand new, 33% lower energy kettle used up to 0.007 kWh ***more*** electricity per boil than the old 3kWh one. Boil a litre of water 5 times a day and the extra totals 4.38kWh, about £3.65 a year (**SAVED £3.65**). Boil a full kettle, 1.7 litres, 5 times a day and the 2kW kettle would cost you £6.39 more. Probably not enough difference to justify changing a good 2kW kettle for a 3kW one but enough to give food for thought when it comes to new kettle choice.

It may seem illogical but sometimes a higher energy device can be more energy efficient than a lower power version. Why? A key factor here is heat loss.

Kettles don't start losing heat after the water is boiled but are losing it all the time the water inside is hotter than the surroundings. The slower 2kWh kettle takes longer to boil so there is more time for heat to be lost during the boiling process.

Caution: Some homes, including our one built in 2008, do not like 3kW kettles. If plugged into anything other than the higher-rated cooker socket, the 3kW kettle tended to trip a circuit-breaker in the electricity box.

Star Tips Worth: £75

Only boil the water you need, boil only as hot as it needs to be and use it straight away.

Chapter 4

Cooking - 1

Savings so far: £200

New savings in this chapter: £519-1,038

Cooking, by its very nature, is energy intensive. The old adage 'time is money' has never been more appropriate than here. However, cooking devices have different levels of efficiency and for different foods. The amount of food needed to be cooked also affects the choice of the best device to use. Other cost factors include pre-heating and whether to cook from frozen or not. We spend about £10 a week on electric cooking, most of ours is done on gas, but how much more would we be spending if we didn't follow the energy saving findings here?

Electric Hobs

Element Hobs

Electrically almost 100% efficient, with all energy converted to heat, but the transfer of that heat is dependent on the heating ring being in physical contact with the pan, for conduction of it to the food. Warped rings or pans easily reduce the amount transferred by 20% to 30+% and, from experience, the amount of heat can be difficult to regulate – taking time to both heat up and cool down. For the most efficient heat transfer, it makes sense not to use a warped pan or one significantly smaller than the ring. Thee part of the ring not in contact with the pan will still get hot but it will be heating your kitchen, not the pan.

Ceramic Hobs

Similar to element hobs, these have their heating elements under a glass cover, making them much easier to keep clean. These too can be considered almost 100% electrically efficient, though they too can suffer similar efficiency losses to element hobs and the same guidance applies. There is also some energy loss due to the heat having to pass through the glass cover - glass is an insulator.

Induction Hobs

Induction hobs are no where near 100% electrically efficient, they are significantly more energy efficient than element, ceramic and gas hobs - working by induction instead of conduction. What does that mean? It means instead of generating heat on the hob under the pan the heat is generated in the pan itself, as if by magic. Because this puts the energy directly into the pan without the conduction losses the other hobs suffer, only induction hobs can transfer up to 90% of the total energy into the pan.

There is an important detail though. For induction to be obtained, induction compatible pans must be used - they must be magnetizable steel or iron, not aluminium or a type of stainless steel that cannot be magnetised. Ideally with thick enough bases for full induction to take place. Remember, the energy is transferred through magnetic induction, not heat – like a wireless phone charger transferring power to your mobile. While your mobile phone gets warm, induction hobs transfer enough energy to cook what ever is in the pan.

One of the claims of induction cooker fans is: “You could put a tea-towel between the hob and the pan and it won't get burned, only warmed.” It will actually get not just warmed but heated to the temperature of the pan – over 100 degrees if cooking with oil and potentially hot enough to catch fire or at least melt it. These are still cooker and need to be respected as such.

As induction transfer is a short-range phenomena, a couple of centimetres at most, there is no loss of induction energy 'up the sides of the pan' - nor is tight contact with the hob necessary, so there is a greater tolerance in terms of pan ring to hob size. If the pan is bigger than the ring the pan base is likely to be thick enough to transfer the heat to whole of the pan, rather than just the point of contact. If the pan is smaller than the hob ring, the induction energy outside the pan edge will have no-where to go so will simply not be consumed.

Hob Conclusion

If it was our home that needed an electric hob, we would choose an induction system. According to research by Which, DEFRA and others, induction is more energy efficient than other electrical hobs and gas hobs but, and it is a big but, due to the significantly higher cost of electricity, cooking on gas remains significantly cheaper than electric; 20 to 50+% cheaper, depending on how you cook – please see Section 2 for more details on gas. If you want to be truly green, also bear in mind 50% of UK electricity is not generated by green systems but often generated in power-stations running on gas or nuclear radiation. No, while nuclear does not generate greenhouse gasses when producing energy, due to the massive of energy, processing and pollution involved in building reactors and handling radioactive waste, nuclear power is not a green energy source.

Overall, the general consensus for the best hob-type features are these:

Hob	**Element/ceramic**	**Induction**	**Gas**
Cost	3rd	2nd	**Best**
Speed	Varies	**Best**	Varies
Efficiency	Varies	**Best**	Varies

While induction is a clear winner in terms of speed and efficiency, the battle for 2nd places depends on how gas and other electric hobs are used, including size of pan to hob/flame. This is covered more in section two, on gas hobs.

Science point: Heat energy can transfer in 3 ways: conduction, convection and radiation (nothing to do with nuclear). Induction cookers effectively use a form of conduction. Element cookers heat mostly via conduction and some radiation. Ceramic cookers mostly via radiation, with some conduction. Gas hobs heat via conduction and convection. The significant point here is, unless otherwise guided, radiation transmits heat in all directions, not just up into the pan you are trying to heat. Conduction is a more direct transfer to the pan, but is dependent on how good the contact is. If you have a slightly bent pan or element surface, the conduction efficiency will be compromised.

Ovens

Full single oven, 1.85kW, 55 litre

The model type on test is a Neue – SCO1SS (CMCB10NH) – not a common brand but works in the same was as all such ovens, using heating elements that are electrically 100% efficient, although not 100% energy efficient as the heat has to pass through an insulator to reach the outside of the element and then pass from there to the food.

It has top and bottom heating elements but no circulating fan. Its power rating is lower than many such ovens, at 1,850 watts combined. More powerful ovens can have that power rating for their top elements alone.

All standard-sized ovens have a fairly large area to heat so the first question is: How much does it cost just to get it up to temperature? Rather than pulling the oven out to plug in the meter, the length of time the red heating light, indicating full power to the heating elements, was logged.

Once pre-heated to 175 degrees, the oven was used to cook a 1kg lasagne from fridge temperature. Now it was up to temperature, the oven cycled between heating (1850W) and not heating (system fan only, about 25W), at approximately 150 second intervals. The total cook of 23.1 minutes (1386 seconds), had heating on for 11.7 minutes (702 seconds), using 0.361 kWh, about 18p. When we add the energy for the pre-heat, the cost almost doubles to 33p.

Pre-heating to:	**100**	**150**	**175**	**200**
Temp rise above ambient 20	80	130	155	180
Time taken	5m 36s	8m 17s	9m 51s	11m 31s
kWh used	0.17	0.26	0.3	0.36
Cost total	8.5p	13p	15p	17.8p

At 175 degrees, once up to temperature though, the heating elements were on 50% of the time, which gives it a consumption rate of

0.925 kWh, about 46p. This cost would be lower for lower temperatures and higher for higher temperatures, though have not measured by how much.

Air-Fryers

Air-fryers come in two basic types: halogen bulb, that run white-hot, and metal loop that can run red-hot. The metal loop types use a heating element just like the one found in a traditional electric oven.

Metal hoop element types, such as Amazon Basics, Tower, Swann and Ninja brands, have become the most popular and were a focus on the June 2023 Channel 4 programme *'Air-Fryers: Are They Worth It?'* Unfortunately, although portrayed as an investigation, it was more a promotional for air-fryers and sometimes misleading.

In all cases, an air-fryer is made up of a heating element; with air blown directly over it then onto the food, close up, in a small space - typically over 10 times smaller than a normal oven. Because the food is under a direct heat blast the cooking effect is immediate and intense. The downside is the smaller space, making them less viable for bigger meals. The upside? Literally no delay or expense in heating the space and focused transfer of heat to the food.

As air-fryers cook by blasting hot air from above, they are not so good with thicker items such as pies or cakes bigger than cupcakes. Because of this, the best-cooked things are pizzas, chicken nuggets, cheese on toast, fish fingers and chips, as well as warming thin pies. Deeper foods, like thick sausages and cuts of meat, can be cooked - as long as they are not too thick or wide, so the air heat can penetrate to the centre via the sides. On the Channel 4 programme they cooked entire meals in air-fryers, including foods in sauces/water, which has to be the most expensive way of cooking such things. A saucepan on a hob, especially a gas hob, would be far cheaper.

1) 17 litre, 1.4kW halogen air-fryer

This is a Wilko branded model, clearly based on an identical one by Daewoo. Halogen bulbs are closer to 90% than 100% electrically efficient as heaters. The rest of the energy is turned into a bright-white light as the thin element inside the glass outer gets white hot, heating up and cooling down faster than traditional elements. In terms of capacity, the 17 litres is massive compared to the 4 litre capacity of most air-fryers. As such it is capable of cooking a whole 10” pizza.

Energy Use	**10 mins, pizza**	**20 mins, chicken nuggets**
1430W max	0.159 kWh (average 0.954 kWh)	0.317 kWh (average 0.951 kWh)

Three to four times smaller than a standard oven and almost entirely built from heat insulating glass not metal, less energy is lost to heating the cooking area so it always uses less energy. Or does it? Interestingly, this air-fryer had a slightly higher energy usage than the main oven once warmed, 0.95kWh compared to 0.92kWh - indicating the thermal insulation on the main oven, once the metal inside has warmed, is slightly better. However the air-fryer only needed seconds to get up to temperature and could finish the entire cook in less time than the main oven took to just get up to temperature.

Frozen (-18C) or Fridge (5C) Temperature?

Does cooking from frozen cost us more? If yes, by how much?

Food	**Energy use**	**Cost**	**Cost** per 100g
Pizza 320g	0.153 kWh	7.7p	2.4p
Chips 470g	0.410 kWh	20.5p	4.4p
Chips 935g	0.660 kWh	33p	3.5p
6 fish fingers (180g) (fridge temp)	**0.220 kWh**	**11p**	**6.1p (27% less)**
6 fish fingers (180g) (frozen)	**0.300 kWh**	**15p**	**8.3p (36% more)**
Chicken nuggets (410g) & chips (470g)	0.533 kWh	26.7p	3.0p

SAVED 27%, by cooking from fridge temperature, not frozen.

Think about it. Food comes out of your freezer at about minus 20. If it came out of your fridge instead, at about 5 degrees, that is 25 degrees less heating you need to pay for. Until it has defrosted, the way heat travels within the food is missing the advantages of liquid/moisture movement to help heat transfer, further increasing the cooking cost. When cooking fish-fingers from frozen it was often found the undersides stuck to the basket but when cooking from fridge temperature they didn't - the undersides got dry enough, fast enough, not to stick. For these reasons, food is allowed to defrost first.

According to my tutor for food hygiene, even at room temperature there is a delay of about 90 minutes before bacteria starts to grow. However, if you are unsure, just defrost the food in the fridge – to ensure it doesn't get too warm..

Why cook from frozen at all? A lot of cooking instructions say to pre-heat the oven and cook from frozen, with cooking times based on this. As an instruction, this offers cooking consistency. The downside is the extra time and cost involved.

This air-fryer was mostly used on 'medium' - marked as 125 degrees, though this identical position is marked 150 degrees on the identical looking and rated Daewoo model it looks based on. In any case, the closer proximity of the element to the food when using the high rack, seems to be equivalent to about 175 degrees in the main oven, which would explain why it is a perfect setting for cooking a pizza.

Despite the surprisingly similar hourly energy cost with the main oven, the air-fryer is often much cheaper to use for two reasons:

1) Unlike a normal oven, there is very little energy wasted warming the smaller cooking area.

2) The fan blows hot air directly onto the food, straight from the heating element - giving food a heat blast from the moment it is turned on.

Update: since starting this book, the halogen bulb in the Wilko unit failed. The opportunity was taken to obtain and test the Daewoo model it appears to be based on.

2) 17 litre, 1.4kW, halogen

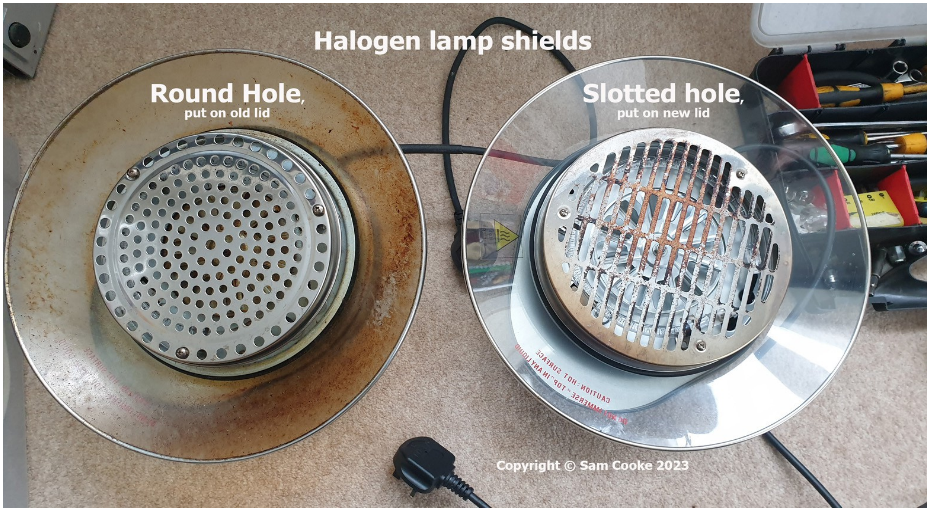
Daewoo model SDA1032, As expected, the performance of this model was almost identical to the Wilko branded version, except the heating dial needed to be set to noticeably higher and cooking seemed to take longer. Upon close examination, the only visible difference was the design of the fan/bulb metal shield - round holes on the Daewoo, slotted holes on the Wilko. Could this make the all important hot air-blast work less efficiently? First some tests. All food starts at fridge temperature, unless otherwise stated.

Food	Daewoo	Wilko
6 fish fingers, 180g (frozen)	0.363 kWh	0.300 kWh (17% saving)
6 fish fingers, 180g	0.253 kWh	0.220 kWh (13% saving)
Pizza	0.222 kWh	0.153 kWh (31% saving)
Chips 470g	0.577 kWh	0.410 kWh (29% saving)
Chips 935g	0.882 kWh	0.660 kWh (25% saving)

Across the board, the perceptions were found to be correct. The Daewoo version was using more energy to cook the food - up to 45% more than the Wilko version. Time for more tests.

First to measure the Daewoo's halogen on/off times, at different temperature settings, with the oven empty for consistency of results. After these tests, the metal heat shield of the Wilko unit was swapped in and the same tests repeated. Nothing else was changed.

To ensure accuracy, a video camera was used to film all these tests, the footage then put on a computer to ensure measurement accuracy. On the next page is a picture of the two different metal shield types and the test results.



For each test the average timings of five on/off cycles were taken. Below are the results.

Temperature setting	**Daewoo** round hole-shield	**Daewoo** Wilko slotted hole-shield
125	5s off / 6s on	8.5s off /6s on
150	5s off /8s on	7.5s off /7.5s on
175	5s off /10s on	6.5s off /10s on

Immediately, there were very clear differences in how the unit was operating after the slotted shield was fitted. While the heating cycle remained almost the same, the cooling cycle ran for longer, meaning less average electricity was being used.

How much did this change actual cooking costs? Preliminary test results were quite astonishing. Same cooker, just different shield.

Food	**Daewoo** round-hole shield	**Daewoo** slotted-hole shield
6 fish fingers, 180g (frozen)	0.363 kWh (18.15p)	0.231 kWh (11.55p - **36% saving**)
6 fish fingers, 180g (fridge temp)	0.253 kWh	0.202 kWh (**20% saving**)
Pizza (fridge temp)	0.222 kWh	0.141 kWh (**36% saving**)
Chips 470g (fridge temp)	0.577 kWh	0.401 kWh (**30% saving**)

Remember, all that has changed is the shield yet the differences in cooking are huge. The slotted-shield has significantly reduced cooking times and energy costs. The reduced number of on/off cycles, combined with the reduced 'on' time is likely to extend not just the life of the halogen bulb but also the unit itself.

Electric Oven Comparison Test

Now the moment of truth. On the Channel 4 programme, their comparison test involved a single potato in an air-fryer and a single potato in a full-sized oven on a middle shelf, which was not put in until the oven was up to temperature. It was an unfair comparison test that would clearly favour the air-fryer - like claiming to compare bus and car costs by having one person in each. Fill the bus with 40 people and get the car to transport 40 people too (multiple trips) and it would be a very different story. For tests to have any meaning, it is important to do them in a real-world way.

In some of the tests below, the bacon was pre-cooked in a pan on a gas hob - further details in the 'Bacon Boosting' box out later in this chapter. Unless otherwise stated, the halogen shield was the round, not the slotted type.

Cooker	Food	Time	Cost (cost/100g)
Main oven + gas hob	bacon - 450g	15+5 mins	20p (4.4p)
Main Oven + gas hob	**bacon - 900g**	**25+5 mins**	**28.9p (3.2p)**
Air-fryer - 1 tray + gas hob slotted shield	bacon - 150g	8+5 mins	8p (5.3p)
Air-fryer - 1 tray slotted shield	bacon - 120g	12 mins	8p (6.8p)
Air-fryer - 1 tray slotted shield	chips - 470g	Not timed	20.5p (4.4p)
Air-fryer - 1 tray	chips - 470g	Not timed	29p (6.2p)
Air-fryer 1- 2 trays slotted shield	**chips - 935g**	About 40 minutes	**33p (3.5p)**
Air-fryer 1- 2 trays	chips - 935g	Over 40 minutes	44p (4.7p)
Main oven (top shelf , no pre-heat)	**chips - 935g**	**32 minutes**	**21.5p (2.3p)**
Air-fryer 1 - 1 tray slotted shield	**1 Pizza - 320g**	**10 mins**	**7.7p (2.4p)**
Air-fryer 1 - 1 tray	1 Pizza - 320g	Not timed	11.1p (3.5p)
Main Oven	1 pizza - 320g	20 mins	22.5p (7p)
Air-fryer 1 - 1 tray x 3 slotted shield	3 pizzas - 960g	30 mins	23p (2.4p)
Main oven	**3 pizzas - 960g**	**20 mins**	**22.5p (2.3p)**

Which is best?

There is no one answer for all situations. Think back to the car vs bus example. Just like with transporting people, it very much depends on the amount involved. In general, if cooking a small meal, one that will easily fit inside the air-fryer on a single layer, the air-fryer (car) wins over the main oven (bus). If cooking larger meals, ones that would need two layers or multiple batches in the air-fryer (car), the main oven (bus) works out both cheaper and faster. The 935g of chips cost 52% more than the oven in the best air-fryer. One pizza in the oven cost 192% more than the best best air-fryer.

If the best cooker, oven or air-fryer, was not chosen but always just one or the other was used, cooking costs could increase by an average of 122%. Choosing the best cooker type and not cooking from frozen the money saved in doing so can be calculated like this.

Weekly spend on these cookers: £10.

Weekly spend if cook from frozen (+35%): £13.50

Weekly spend if not choosing best cooker (oven, hob, air-fryer): £29.97 (+122%). This is almost 3 times the current amount and would cost not £520 but £1558 per year; £1038 extra. Although this is the maximum extra, the likely extra would be a good £500 and illustrates the importance of cooker choice.

SAVED £519 - 1038 by not cooking from frozen and choosing the best cooker, based on efficiency for the food being prepared.

Additional savings, not included in the calculation:

If you have a gas alternative, also consider that. Gas energy is less than half the price of electrical energy. Pre-cooking the bacon on the gas hob gave a **28%** cost advantage. A further **36%** was saved in air-fryer cooking by swapping the shield. If you are going to buy one of these models and the picture on the box shows slotted or round-hole shield, you know to go for the slotted shield.

If you have a gas hob, some foods can be pre-cooked on that before being 'finished off' in an oven. For example, bacon - detailed in the bacon boosting box out on the next page.

Bacon boosting: Apologies to vegans and vegetarians for this example choice but many things do not need to go into a pre-heated oven, including bacon. Before cooking a tray of bacon in the main oven we first pre-cook it in a lidded, 28cm frying pan on the hob, on a low heat - one 300g, 10-slice packet at a time. No oil is added. As the bacon is warmed (about 5 minutes per pack) most of the added water is released into the pan, making the bacon going onto the oven tray drier and able to crisp faster; as well as making less mess. Crisping faster means less electricity/cost.

Once the oven tray is full, with 15 slices (450g) it goes onto the highest shelf in the still cold oven. Only now is the oven turned on, top and bottom elements and set to 175. Fifteen minutes later we have a 15-slices of perfectly cooked, crispy bacon. The second 450g batch goes in and, now oven warmed, cooks in just 10 minutes.

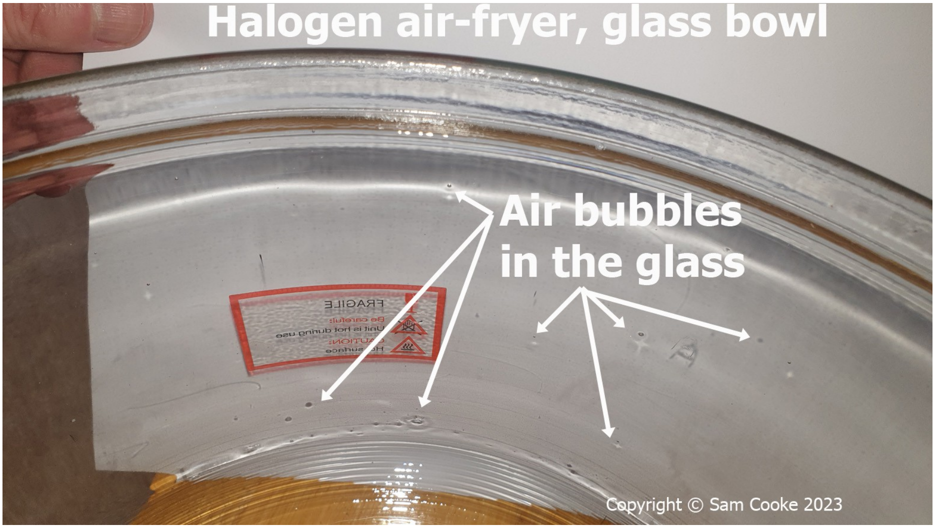
Total cost for the 900g of bacon? Electricity 26.4p, gas 2.5p. What would it cost to be cooked entirely in an air-fryer, as Channel 4 were promoting? What would the cost/time difference be if it was also pre-cooked on the hob first? We measured both ways to find out, 4 slices at a time (5 after pre-cooking on gas hob as they shrink) as that is all that would fit.

Extra information for glass-bowl air-fryers

Glass bubble warning: in 2020, when our first Daewoo air-fryer needed replacing, the identical-looking Wilko unit was bought but its glass bowl was found to have small air bubbles and tiny cracks.

Upon heating some of the air-bubbles popped and pinged tiny bits of glass into the bowl. Took that item back for a replacement, which had exactly the same issue. Rather than taking it back again for a refund, it was decided to just re-use the original, bubble-free glass bowl.

Fast forward 3 years and the brand new Daewoo model arrives with exactly the same issue of air-bubbles and tiny cracks in the bowl.



It might be because of recycled glass as have also noticed small air bubbles in a bottle of cider. With cold drinks there is no fear of such bubbles popping but with the glass heated by an oven, there is.

Slow Cookers

As the name suggests, these cook food over a slow, extended period of time, using a low heat. While this makes them convenient it also makes them very energy inefficient. Why? Because heat is continually lost over the cooking period and such long cooking periods loose a lot of the heat energy put in. The manufacturers know this so do not put in a thermostatic switch, as you have in ovens and sandwich toasters, meaning these are heating continuously.

Some 'experts' say slow cookers cost just 16p a day to run. When? 1972? From what is measured here, the only time they will get close to that is when put on the lowest setting, just to keep food warm not to cook it.

3.5 litre Slow Cooker

The test model is a 210W Crockpot, SCV400KB. There has been so much talk about the low energy cost of low-energy devices, including slow cookers, it was decided to perform the ultimate energy comparison test: boiling one litre of water in a 210W slow cooker vs one litre of water in the 2kW (2,000W) and 3kW (3,000W) kettles. Here's what the slow cooker achieved.

Setting	Energy	Cost/hour	Cost/8 hours	To boil 1 litre
Standby	0	0	0	N/A
Warm	47.1W	2.35p	18.8p	N/A
Low (75% of High)	161.7W	8.1p	64.9p	abandoned after 6 hours, (85 degrees)
High	210.4W	10.5p	84.2p	abandoned after 2.5 hours, (95.8 degrees)

After achieving 95.8 degrees on high, 210W, the slow cooker was switched to low (75% of high), to measure the temperature again after another hour. How much more would it go up? It went down. After another hour, it had dropped to 85 degrees - indicating it would never achieve more than 85 degrees on low.

Thankfully, a lot of food does not actually require boiling point for cooking. You only need about 65 degrees for most vegetables and about 85 degrees for most meats, achieved on both the low and high settings, eventually. Slow cookers have a very lower energy consumption kettles but does that make them more energy efficient?

210W Slow cooker VS 3Kw electric kettle

1 litre of water in kettle	**1 litre of water in slow cooker**
0.103 kWh for 100 degrees (3kW)	0.103 kWh for 37.9 degrees
0.107 kWh for 100 degrees (2kW)	0.107 kWh for 38.2 degrees

Why can a kettle boil the water when the slow cooker can only manage up to 38 degrees for the same energy? Why is five times more energy needed for the slow cooker to get water even close to boiling? The only answer we can find is heat loss over time - think back to the difference between the 2kW vs 3kW kettles, only now with much more time for it to take place.

While the kettle only allows a few minutes for heat to be lost, the slow cooker allows hours - losing most of the heat to the heat your kitchen, not the food

Heat Loss: The greater the temperature difference of something (hotter or colder) compared to the surroundings, the faster the temperatures will equalise. A cup of tea on your garden table will cool much faster in winter than summer.

As a 2kW kettle takes longer to heat water than a 3kW one, there is some more time for heat to be lost during heating. Slow cookers heat for hours and it is this that allows so much heat to be lost - also the reason for the 'Hot' warning labels on it; when the inside temperature was 95 degrees, the outside was 85.

Slow cookers are convenient cooking devices but put them on low, before leaving for work and after 10 hours, they will have cost some 80p in electricity; the equivalent to running a 400W halogen heater for 4 hours.

Star Tips Worth: £500+

Small ovens (air-fryers) cheaper for small meals only.
Larger meals cheaper in larger ovens.
Avoid cooking from frozen.
Slow-cookers loose most of their energy.

Chapter 5

The Living Room

Savings so far: £719-1,238

New savings in this chapter: £69

Televisions

No apologies for not testing cathode ray, plasma or tungsten projector televisions. These are all energy hungry devices, which were great in their day and will be fondly remembered, but now have no place in the modern world - beyond museums or film sets. If you still use one, just know your electricity consumption might be ten times higher than an LED alternative. You can usually see when devices are energy hungry as they need cooling fans, vents and fins to shed the heat generated.

While the actual power consumed by different television models/brands does vary, things that affect LED TVs here will similarly affect your LED TV too - the technology is fundamentally the same.

1) Flatscreen 40" HD LED

On test is a Samsung UE40D5003 flatscreen O-LED television. It offers four power modes, plus screen off/audio-only.

Except for the picture off, sound off test - the 20W maximum sound rating was set at 20 out of 50, which still sounds quite loud but made no measurable increase in energy consumption.

Annual usage: for all audio/visual devices in this chapter, the cost per year figure when on is calculated as 5 hours a day, 365 days a year (1825 hours). The cost per year for standby is calculated as 24/7, 365 days a year (8760 hours) – which is the cost of having the device plugged in even, if it is not used all year.

40” O-LED	**Watts**	**5 hours**	**Year** (5 hrs a day)
Standby	0.5	0.002 kWh	£2.19 (24/7)
Picture off, sound off	18.9	0.094 kWh	£17.16
Picture off, sound at 20/50	18.9	0.094 kWh	£17.16
Picture on, High energy saving	27.8	0.139 kWh	£25.37
Picture on, Medium energy saving	36.3	0.182 kWh	£33.22
Picture on, Low energy saving	45.1	0.226 kWh	£41.25
Picture on, no energy saving	76.7	0.384 kWh	£69.99

SAVED up to £44.62 (65%) a year but running our backlight on high energy saving. If watching a film, especially a darker film like Batman, I change it to 'medium' energy saving - still 50% cheaper than brighter settings, with almost no difference in viewing.

2) 32” HD LED

This smaller screen Sony Bravia, model KDL-32W705B, is also LED technology. After turning this television off using the remote control, it drops it into a high-level standby, using 8.5W, for a few minutes before dropping itself to a low-level standby, of 0.5W, as with the Samsung. Unlike the Samsung, there was no true 'picture off' option and no energy saving modes. Instead we manually changed the brightness/backlight level and measured that.

32” LED	**Watts**	**5 hours**	**Year** (5 hrs a day)
Standby	0.5w	0.002 kWh	£2.19 (24/7)
Picture – backlight 0 (min)	25.4w	0.127 kWh	£23.18
Picture – backlight 1	26.4w	0.132 kWh	£24.09
Picture – backlight 3	30.8w	0.154 kWh	£28.11
Picture – backlight 5	37.4w	0.187 kWh	£34.13
Picture – backlight 7	42.4w	0.212 kWh	£38.69
Picture – backlight 10 (max)	50.8w	0.254 kWh	£46.34

SAVED: £22.25 (48%) by running this on backlight level '1', again unless a film or game requires brighter viewing - for which it is turned to '3' or '4' for that time.

Conclusion

On both televisions, by far the biggest impact on power consumption was the screen brightness level. Savings of at least 48% were gained by having the screen brightness lower than maximum but still plenty bright enough for most situations. Our biggest TV was 40”, small by modern standards, and with that we saved £44 a year. The bigger your TV the more a 48% saving will be worth. For example, a running cost of £200 could be dropped to £104.

Adjusting the brightness/contrast settings seemed to make little to no difference, as these do is affect the way the backlight level appears – think of it as a mask/shade over a lamp. The only thing that affects the energy the lamp (backlight) uses is the brightness of the lamp itself.

Unlike screen brightness, different sound levels made very little difference. A 20W sound rating doesn't mean 20W of actual power but 20W of peak power. In reality the 20W rating translates into a maximum of about 2W.

Science point: Ever wondered why adverts sound louder than the actual television programme? Contrary to what many people think, the peak sound levels are no higher. What is higher is the effective power of the sound, by raising all the different wave frequencies closer to the peak.

Think of the level of sound as the level of waves in choppy water. If you could add extra water, to fill the wave troughs, you would have more water at the maximum level. Filling these troughs in sound waves gives us more sound at the maximum level, making it more powerful, without increasing the peak level.

Freesat boxes

1) Freesat with USB Record Option

A small, basic Freesat V8S model, without an internal hard-disk – recording instead to a USB memory stick, when attached.

V8S	**Rating**	**5 hour cost**	**Year** (5 hrs a day)
Standby	0.5 W	minimal	£2.19 (24/7)
On	8.8 W	2.2p	£8.03
On with USB stick	9.4 W	2.4p	£8.76

2) Freesat with internal Hard Disk

Now a Humax Foxsat HDR with the addition of an LED display, internal hard drive and friendlier operating system. Out of curiosity , the original 500GB hard disk was replaced with a brand new 1000GB (1TB) Western Digital 'purple' disk, specifically designed for continuous video recordings from multiple feeds – the Humax can record two programmes at the same time. I had hoped to see a noticeable drop in power consumption but this was not the case; the original disk was clearly energy efficient as well. The biggest advantage of putting in a new disk was not just the doubling of storage but the knowledge it was unlikely to fail any time soon.

Unlike other hard-disk models, including Western Digital's 'purple', 'red' and 'black' disks, have proved massively reliable over the years; as have Samsung EVO SSDs and most Kingstons. Other brands have failed under long-term use, hard disk and SSD. Not going to shame them here but if a manufacturer only offers a 1-year warranty on their hard-disk, ask yourself why. If they have no faith in it, why should you? Data loss from disk failure is far more painful than paying a bit more for a more reliable drive in the first place. When drives fail, they often fail completely, without warning.

Foxsat HDR	**Rating**	**5 hour cost**	**Year** (5 hrs a day)
Standby	1.3W	0.3p	£5.69 (24/7)
On – SSD disk	19.3W	4.8p	£17.61
On - WD 'purple'	22.5W	5.6p	£20.53
On – original disk	23.5W	5.9p	£21.44

With the original hard disk, this unit took around 23.5W in use. With the 'purple' hard disk this dropped to 22.5W. The only way to drop energy use more was put in a solid-state 'disk', an SSD. This wasn't planned but, as the 'purple' drive was optimised to be always on, there was an incompatibility with the way the Humax turned it on and off several times a day. It didn't mechanically fail but the data became corrupted - needing a reformat to resolve things, which also erased the recordings made. The only solution was to return to the original drive or try an SSD.

A 400GB Kingston SSD was installed, using a 2.5” to 3.5” adapter. This dropped maximum power consumption to 19.3W and works perfectly. Although that is a 20% power saving, over the course of a year, at 5 hours use a day, it is only about £4; not enough to cover the cost of buying the SSD.

What ever you record things to, if there is a valuable programme, back it up to another device, such as a USB memory stick. Never trust important data to one physical device.

Other Devices

A) DVD Player - Blu-Ray

The test model was an LG BP255 player, with USB and ethernet.

Blu-Ray	Energy use	5 hours	Year (5 hrs a day)
Standby	0.6W	0.15p	£2.63 (24/7)
On - no disc	4.0-4.9W	1 to 1.2p	£3.65 to £4.47
Playing disc	5.0-5.9W	1.2 to 1.5p	£4.56 to £5.38

B) Mini Hi-Fi System

Test model, Samsung MX-J630 230W, with a 'Giga-Sound' feature does a similar thing to the advertisements on television. It boosts the quieter sounds closer to the level of the louder sounds – significantly increasing the power of the sound produced at any given volume level.

Samsung 230W	Energy use	5 hours	Year (5 hrs a day)
Standby	0.6W	0.1p	£2.63 (24/7)
On, zero volume, radio/aux	10.6W	2.7p	£9.67
On, zero volume – CD playing	11.5-12.4W	2.9 to 3.1p	£10.49 to £11.32
On, volume 5 of 20	10.8W	2.7p	£9.77
On, volume 10 of 20	10.9W	2.7p	£9.86
On, volume 10 of 20 – Giga sound activated	10.9W	2.7p	£9.86
On, volume 20 of 20	11.1W	2.8p	£10.12
On, volume 20 of 20 – Giga sound activated	14.3-16.8W	3.6p to 4.1p	£13.05 to £15.05

SAVED: very little financially. All that can really be saved is £2.63 by turning it off at a switch where it plugs into a socket, and this has already been counted in Chapter 1. With a more powerful system, especially a stack system with a lot of separates, the standby power is likely to be a lot higher and switching it off at the plug(s) could save you over £10 a year.

C) Cyclonic vacuum cleaner

This VAX U87-MA-Pe, Pet Air HEPA is a cyclonic bagless, 9-year-old vacuum rated at 820W, and A-rated for both carpet and hard-surface cleaning. The only servicing done has been to clean/replace the filters and de-hair (human – not pets) the roller brush.

	Roller and main unit	**Bare hose only**
Standby	0W	0W
Minimum	690.8W	119.3W
Maximum	1003W (1143W, almost full)	887.2W
Running	920 to 980W	799.5W
Cost hour	46 to 49p	40p
Cost year (1 hour a week)	£23.92 to £25.48	£20.80

Although it makes sense for more power to be needed when the dirt container is more full, I hadn't planned to actually measure how much. I just happened to measure the unit before and after emptying, on the same carpet surface. The difference is about 10% more power needed when almost full compared to when empty. Given bagged systems have to pull the air through the dirt bag itself, with the dirt all tending to mass at the vacuum end, I would expect the power difference to be significantly more when a bagged system gets near full.

Our previous vacuum cleaners were all bagged items and rated at around 2kWh, over twice the power of this unit. None, including previous VAX units, have ever sucked as hard or cleaned as well as this, which even attains HEPA filtration in the process. It is a perfect example of what can be done with good design rather than relying on brute power and is definitely a major step forward.

SAVED: about £2, 10+%, by keeping the bagless vacuum cleaner dirt container under half full. On a bagged system, especially one needing 2kW to run, the benefits are likely to be £10 or higher, as the bag itself can become restrictive to airflow. The harder the vacuum motor has to work, the more electricity its motor will use.

D) Bagged vacuum cleaner

This Henry – HVR160 was rated as lower energy than the VAX (620W compared to 820W) but was found to consume more than its rating too - at around 700W. While the Henry had a smiley face, it didn't make up for it not being HEPA capable, didn't suck anywhere near as well or have the roller brushes to help remove dirt, which didn't make us smile. Despite being incredibly popular, this is an old-tech bagged system.

Conclusions

Bagged vacuums were great in their day - cyclonic vacuum cleaners are a technical leap forward and maintain suction much better as they fill. Most need under 1000W to run - just check availability/cost of new filters, as well as reviews and cleaning ratings before purchase. This VAX has HEPA filtering and is grade-A rated for cleaning for both carpet and hard flooring, along with widely available non-VAX branded filters for under £10 the pair, have made our VAX a winner. Eight years old and still going strong.

Do not neglect filter cleans/changes, hair build up on roller brushes or dirt build up in the collection container - all can reduce the life of the unit by making it work harder. And if it is working harder it will use more power and cost you more too.

Star Tips Worth: £70

Put TV screen brightness on low/economy. Empty your vacuum sooner rather than later. A multi-way socket with off switch(es), for are convenient ways to cut standby usage.

Chapter 6
Kitchen Smalls

Savings so far: £788-1,307

New savings in this chapter: £ N/A

There was no measurably accurate way to calculate how much we could save by adopting something like a sandwich toaster over a toasted sandwich in the air-fryer so have marked this chapter as not applicable savings wise, though hope you will still find it useful.

Toasters

Toasters are like plug switches – either on or off, so no standby current; though please remember the internals will still have 240 volts of live electricity so no poking inside unless unplugged from the socket.

A) Budget toasters, 2-slice, 780 – 870w

Morrisons and Lidl branded.

Cost per hour, continuous: 41p

Standby power, 0W, cooking power 0.83kWh. Note there is no difference in energy consumption if one or both of the cooking slots are used, so the best way to save electricity is to cook two slices at once, rather than one then the other.

	Energy used	cost
Toast (1 or 2 slices)	0.022 kWh	1.1p
Crumpet (1 or 2)	0.045 kWh	2.3p

B) Budget sandwich toaster, 700W

Tesco branded.

Cost per hour, continuous: 18p

This was found to be surprisingly energy efficient, thanks to the very close proximity of the heating elements to the food, the enclosed nature reducing heat loss and the thermal cycling of the heating elements – see below.

Power consumption on, not heating (red and green lights) less than 0.5W; heating (red light only) 0.72 kWh. As these units have a thermal switch, only half their time is spent heating so the average usage cost drops to about 0.36 kWh.

C) Electric Coffee Grinder

Lidl SilverCrest SKMS 180 A1. It was surprising how much electricity was used on both standby and when running, although it only needs to run for such a short time, calculated at 30 seconds a day.

Standby	0.8W	£3.50 year
Grinding (30s)	130W (0.04p)	21p year (once a day)

This shows the value of turning things off at the plug. The electricity this grinder would use on standby is 16 times more than it needs to be used to run it every day for a year.

Coffee grinder note, for coffee lovers. Like many coffee 'grinders', this one does not actually grind but cuts up the coffee beans with a spinning blade. Rather that getting even-sized grinds, your beans end up a mixture of small chunks and powder, small enough to pass through filters. Not good if you suffer from any kind of irritable bowel syndrome. Worth bearing in mind.

Chapter 7

Refrigeration

Savings so far: £788-1,307

New savings in this chapter: £88 - 153

Not all fridge-freezers are energy equal. As they run 24/7, 52 weeks a year, the differences in running costs between different models can be more than I think.

1) Old A-rated, 150L fridge/75L freezer, 317kWh/yr - £158/yr

A frost-free Hotpoint FFA52P. Bought in 2009, this fridge-freezer is 14 years old and had proven totally reliable until became reluctant to restart after a power cut 3 years ago, making a horrible noise from the compressor. Turned it off, waited for a bit then turned on again. Silence. Then, after a 30 minute delay, it began working normally and worked perfectly for another 3 years, until a month ago (at the time of writing) - when it began to buzz from the top. Research indicated the buzzing was the relay on the control PCB (board). A replacement PCB was between £80 and £140 just to buy – more than the entire unit would be worth even when fixed. Given the age and possible something like the compressor could soon go wrong too so researched for a replacement fridge-freezer. Kept this one limping along in the meantime, by turning it off on the top dial, just for a few seconds, when it started buzzing and gradually working our way through the food contents – adding old coke/juice bottles filled with tap water to help keep the contents cold enough when turned off over night. As an engineer, out of curiosity began looking into repairing the PCB – see the 'Repair?' box out.

According to the FFA52's official rating of 317kWh a year, it costs £158.50 a year (£3.05 a week) to run. There are 3 shelves in the fridge section and, as heat rises, the lowest shelf is colder than the highest so I kept meats, cheeses and milks on the bottom shelf or in the drawers below it. Less sensitive foods, like bread or vegetables, were kept on the middle and top shelves.

As a rule, refrigerated food needs to be kept 8 degrees or lower but above 0 degrees, which was still achieved on setting 2 but on setting 1, at the high end of the cooling cycle just before the compressor kicked in again, the top shelf hit 10.2 degrees – fine for cooling a fizzy drink or even vegetables but not for preserving foods like meats or dairy. The table below shows maximum measured temperatures per shelf, on setting 2.

Setting 2	Bottom drawer	Bottom shelf	Middle shelf	Top shelf
Temperature	2.4 max	3.6 max	5.6 max	7.4 max

After the new fridge-freezer arrived, stripping down the old fridge to get to the PCB could begin. All the glass shelves were removed and recycled into a heat-proof soldering worktop. This meant the next tests were run with the max/min digital thermometer placed on top of a 4” (10cm) high plastic tub. The purpose of these next tests was to measure the difference between fridge setting, temperature and energy usage. Without the shelves the normal design airflow would be missing, so the readings are less representative of what would have been food temperature per shelf but still represent the differences between the settings.

Before each test, the unit was given 24 hours to settle to the new setting. Energy usage was then measured for the next 24 hours, along with the maximum and minimum fridge-freezer temperatures. This unit does not have individual settings for fridge and freezer sections. Instead there are 5 coldness settings, on a single control dial; from 1 the lowest to 5 the highest/coldest. For the 14 years of ownership it has been run on setting 2. The theory was to run it cool enough to preserve the food, without needlessly running it colder and using more power for no noticeable gain. Running it on 2 instead of a higher setting also meant the entire cooling system was working less hard. Given it lasted 14 years of continuous, busy family use, including a home move, it would seem the theory worked quite well. So, what about the energy consumption versus temperature? As the fridge was in the process of failing, only the results for two settings were collected but these were enough to illustrate the level of differences. Remember, the fridge no longer has any shelves or drawers.

Temp setting	**Fridge** (min/max)	**Freezer** (min/max)	**Energy** (24hrs)	**Energy** (year)
2	-0.8 to 4.5	- 11.8 to – 25.8	0.755 kWh	275.57 kWh £137.79
4	-2.5 to 4.6	-17.9 to – 30.7	1.237 kWh	451.51 kWh £225.76

It was interesting the fridge section went below zero degrees on both settings and, in recent years, had noticed a tendency to for some food to freeze in the bottom of the right hand drawer, the coldest part of this fridge. I don't remember this happening in earlier years – though have no way of testing that memory now.

Saved: £87.97 running our old fridge on setting 2 instead of setting 4, or higher. Over the course of the 14 years it lasted for, that's a total of £1232 at today's prices.

Most significant is the difference in energy demands between the temperature settings. This unit has an official annual rating of 317kWh/yr and on setting 2 it was below that, at 276 kWh/yr. On setting 4 it was significantly above it, at 452 kWh/yr. At 50p a unit, that's a cost difference between the settings of over £110 a year; 64% more on setting 4, for effectively doing the same job.

As the cooling system's work load was directly related to the amount of energy used to power it, on setting 4 the cooling system would have been working 64% harder. Think of it like driving your car gently or hard. The harder you make it work, the fasting things wear out. A pro-rata 64% rate would give a reduction in working life from 14 years to 8.5 years – still a good number but significantly lower.

Repair? The only component near the top of this unit capable of making a buzz was the control board relay. Whether the relay was buzzing because it was faulty or whether it was buzzing because the circuits feeding it were faulty, I had no way of telling. Visually everything looked fine and, as the only component with moving parts to wear out was the relay, I bought a new one to see if it would fix the issue. It didn't. Exactly the same problem was still there so either a component on the PCB that feeds the relay has gone or there is some issue with the item feeding the PCB or drawing power from it. In any case, it was worth the try but not worth spending more time or money to investigate further.

As a footnote: when stripping the electrics out of this unit before it was collected by the council for recycling, I noticed a switching unit at the compressor had signs of overheating. I suspect this was the faulting item, not the PCB it was connected to. No way of testing now...

2) D rated, 227L fridge/103L freezer, 201kWh/yr - £100/yr

A frost-free Leibherr CND 5203. After literally days of research, decided on this fridge-freezer unit and bought one brand new. Despite storing significantly more, its new D-rating indicates it should use a third less energy than the old fridge, theoretically saving around £58 a year and another reason energy efficiency was a key consideration when choosing this unit.

The old fridge was good at its time, with its old A-rating label roughly equivalent to new F-rated units, each needing around 300kWh a year to run. A good-brand similar sized F-rated fridge could have been bought for £100 to £150 less than the D-rated one chosen but, based on a working life of at least 5 years, saving £58 a year in electricity means this purchase will cost £290 less to run during, making it effectively cost less than a cheaper-to-buy F-rated alternative. If it manages to last the same 14 years of the previous unit, it will save £812 in electricity – enough to buy another brand new fridge-freezer and take the family to a restaurant to celebrate.

Unlike the single dial system of the old fridge, this has a dual control with LED display. Out of the box it is set to 5 degrees for the fridge and -18 for the freezer. The more modern design means the temperature remains more stable. However, given the cyclic nature of cooling the temperature ranged from 3.5 to 6.7. Setting the fridge to 3, gave it a temperature cycle of 1.5 to 4.8.

The bigger questions is what difference do temperature settings make to energy consumption? They were measured over 7 day periods, after giving the unit 24 hours to adjust itself to the new setting. Due to this unit being 'in use', by that I mean the doors are opened throughout the measuring period, these readings are given as guideline, real-life measurements.

Degrees set fridge/freezer	**Fridge** (actual)	**Freezer** (actual)	**Energy** (Year)	**Cost** (Year)
5/-18	3.5 to 4.6	-13.8 to -18.2	155 kWh	£77.50
5/-20	**3.5 to 6.7**	**-16.8 to – 21.3**	**145 kWh**	**£72.53**
3/-20	2.2 to 4.2	-13.5 to -20.8	152 kWh	£76.23
3/-25	2.5 to 3.6	-21.8 to – 26.8	173 kWh	£86.69

Even with the fridge set to 3 and the freezer set to minus 25, 73 kWh/yr is still 28 kWh/yr below the quoted annual consumption. Interestingly, the most economical setting was not 5/-18 but 5/-20, which results in 56 kWh/yr below the quoted consumption. These also seems to be the most economical settings for this unit.

Differences between new and old units.

1) Even with the new unit being in active use, the temperature fluctuations are better controlled and it wastes less energy on excessive cooling – the old unit would swing to below minus 30 and sometimes froze the bottom of the fridge section.

2) The new unit compressor typically draws 20 to 35w when running, compared to the 70 to 90w seen in the old unit.

3) The real-life energy consumption of the new unit is less than half that of the old unit.

It seems the efficiencies are due to a combination of better thermal insulation and a gentler, lower energy compressor, coming in more regularly to keep the temperature to the required level. With the old fridge, the compressor would tend to come on for longer, cooling the contents significantly more than needed so it could then turn off for longer too; such an up-down temperature cycle is clearly less efficient.

SAVED: £87.97 to £153.23 via fridge/freezer and setting choices. Setting 2 choice on the old A-rated unit saved £87.97 a year. Upgrading it to the new D-rated unit now saves an extra £65.26, totalling £153.23 a year. Over the lifetime of the unit such savings will more than pay for the purchase. The purchase has not been taken off these savings as a fridge/freezer is an essential item and would need to be purchased regardless.

Science point: Cool more then compressor off longer or cool just enough and compressor on more?

The old unit would bring the freezer section down to -25 or even -31 centigrade, which takes far more electricity than the new fridge taking the temperature down to -19. Win one for the new unit.

If room temperature is 20 degrees, the difference between room and new freezer is 39 degrees (-19 to plus 20); with the old it is 51 degrees (-31 to plus 20). A temperature difference of 51 degrees is going to lose cold significantly faster than one of 39 degrees. Remember our boiled water losing heat faster the hotter the water? Same thing – it's like a pressure difference. The greater the temperature 'pressure' difference between things the faster the 'pressure' will try to equalise. Win two for new unit.

The new unit also has double the thickness walls and doors for greater thermal insulation with the outside – giving it a 24-hour power cut survivability, compared to the 9-hours of the old unit; further reducing the mount of cold lost. Win three for the new unit.

If a compressor doesn't need to work so hard a less powerful, and less energy hungry, item can be fitted. The action of compressing refrigerant generates heat. On the old unit a large, cooling 'plate' is needed at the back to deal with it – ironically warming the back of the fridge in the process. With the new fridge and its lower energy compressor, there is no visible cooling 'plate', just an air-gap at the rear – which must home one of some kind, though clearly not one requiring any where near the same level of heat dissipation. As generated heat is relative to the energy used to generate it, this is win four for the new unit.

Tip: the less a fridge/freezer door is opened the less warm air/moisture will be let in and the less the compressor will need to come on. When the compressor is off the fridge uses just standby energy. For this reason, if need more than one thing, why not try and grab them at the same time?

3) E-rated, Electric Cool/Hot Box, 29 litre, 69kWh/yr

A Lidl Crivit CEK29B4. In 2022, given the age of our Hotpoint fridge-freezer unit, this was bought as an emergency back-up in case it suddenly failed. F-rated, this box was only ever intended to be a temporary measure, so I didn't worry that is wasn't more efficient. Have recently seen the latest versions of these boxes rated as E, equivalent to many new full-sized fridge-freezers. For our model, as long as it could keep food below 8 degrees, cool enough to stop it going off, we would be happy.

As portable devices, electric cool/hot boxes do not quote temperature but 'degrees below/above ambient', this cool box is rated up to 20 degrees below ambient. Meaning it can keep food at 8 degrees or lower, as long as the ambient temperature is 28 degrees or lower.

The cold test was run at the relatively low ambient temperature of 17 degrees. At 17 degrees, for this unit to meet its maximum cooling of 20 degrees below ambient, it would have to achieve minus 3. Almost empty, it achieved -0.8 within a few hours and could have potentially achieved -3 if given more time. In summer months, with ambient temperatures above 20 degrees, there is every confidence it would achieve the claimed 20 degree maximum drop.

Cooling Mode	**Power** (cost per 8 hours)	**Cooling temperature**
Standby	0.7 to 0.9W	N/A
Eco	6 to 7W (2.4 to 2.8p)	8.8 7.9 below ambient
Max	53.8 to 59.4W (21.5 to 23.8p)	-0.8 17.8 below ambient

Pareto: The Pareto Effect states that you can get 90% of the results for 10% of the effort, others quote it as 80/20 or 70/30. The point is you can get a lot of the results for significantly less than maximum effort. This is born out here with this coolbox. Half the temperature drop (10 degrees below ambient) can be achieved with a tenth of the maximum power – and a lot less noise. Not as loud as a hair-dryer but heading in that direction.

In the same way that heat pumps work like fridges in reverse, this coolbox can also be put into reverse turned into a hotbox. On maximum power it was noticeably quieter in heating mode and the power consumption was less too – suggesting greater efficiencies in this mode.

Heating Mode	**Power** (cost per 8 hours)	**Heating temperature**
Standby	0.7W	N/A
Eco	6.4W (2.56p)	24.1 7.5 above ambient
Max	42.9 to 52.4W (17.2 to 21p)	39.5 18.2 above ambient

SAVED £65.26 a year on the running costs of the old unit on setting 2, and £153.23 compared to running it on setting 4. It illustrates the value of running units only as cold as they need to be, not as cold as they can be.

Our annual fridge/freezer running costs have dropped from £137.79 to £72.53 - a 53% reduction and now just £1.39 a week.

Star Tips Worth: £90+

A better energy rated fridge-freezer (D rather than E) can pay for its extra cost in under two years. Run it only as cold as it needs to be, not can be - such as 5c fridge, -20c freezer.

Chapter 9

Washing Machines

Savings so far: £876-1,460

New savings in this chapter: £57

In this chapter we break away from the normal format of measuring device consumption at different stages. Instead we are using the device's on-board measuring system to calculate things.

The biggest energy consumption differences with modern washing machines comes from heating the water - the hotter the water the higher the cost. How high?

Sandstrøm S814WMW13

Old A++ rated, 8kg, 1400rpm, 210 kWh/yr

On a 30-minute cold wash (zero heating), it used just 0.161 kWh, about 8p, double that for a full wash. If the heating element had been used the energy usage would have increased by 2.2kWh for the amount of time the element was on; at a cost of 1.8p a minute.

Setting	Short - 2kg	Heating Cost	Full - 8kg	Heating Cost	Cost/year 3x 8kg/week
Cold	28 mins	0	49 mins	0	£24.96
20	33 (+5)	9.2p	59 (+10)	18.3p	£53.51
40	38 (+10)	18.3p	69 (+20)	36.7p	£82.21
60	est +15	est 27.5p	est +30	est 55p	£110.76
90	est +25	est 45.8p	est + 50	est 91.7p	£168.01

The LED display on this machine gives a timer that changes according to the temperature selected - based on the time needed to heat the water. As the cost of each minute of heating can be calculated, so can the cost differences on a variety of different settings. Where the higher temperature setting wasn't able to give a predicted time prior to starting a wash at estimate was made.

Saved: £57.25, by dropping the temperature from 60 to 20. More savings would be had by dropping it to cold - about 15 degrees in practice. Washing more often or less than 3 times a week would increase or decrease the cost pro-rata.

Chapter 9

Other Devices

Savings so far: £933-1,517

New savings in this chapter: £ 270

A) Landline Phone with LCD display and answerphone

This is a BT Decor 2600 Premium, a mid-range wired telephone, with LCD display, answerphone, speaker-phone and 200 memory address book. It needs to be permanently plugged into the mains to power the features but still works as a basic telephone, using power from the telephone network, if mains power is lost – important in an emergency if there is a power cut.

Energy usage	**Energy** (year)	**Cost** (year)
0.6W	5.3 kWh	£2.63

B) Clock Radio

This small Tesco CR106R, clock-radio surprised me. It was never expected to use much power but what surprised was it used 30% more power with the radio off than on as just a clock. So surprising it was measured three times to be sure. Never seen anything like that before.

Energy usage	**Energy** (year)	**Cost** (year)
Clock only: 1.3W	11.39 kWh/yr	£5.70
Clock and Radio: 1.0W	8.76 kWh/yr	£4.38

It has AA-battery back up for the clock, for which I use rechargeable batteries, this is now turned off at the mains plug unless in use.

C) Light Bulbs

With all but LED bulbs being banned for domestic usage, here is a general comparison between the different bulb types. There will be differences between different brands and bulb types but this still gives a good general comparison between the technologies.

Bulb type	Light per Watt (lumens)	Relative light output
Tungsten filament	16 lm	100.00%
Tungsten filament with halogen	20 lm	125.00%
Fluorescent	60 lm	375.00%
LED	150 lm	938.00%

Where does the energy go that is not light? Heat.

While standard tungsten filament bulbs run burning hot, halogen-filled bulbs run even hotter – which helps them produce more light and made them a good upgrade in headlight bulbs, until xenon then LED bulbs came along. It is because halogens run so burning hot they have been adopted for cooking, such as in air-fryers.

LED bulbs are the best current technology and domestic versions come as dimmable or non-dimmable. For both types there are further options of visible filament and opaque. The filament types look great and output a bit more light for the energy but also cost more. If hidden inside a lampshade, why not opt for the cheaper opaque type. In both cases, LED efficiency is vastly better than the previous technologies.

While light bulbs themselves use no electricity when switch off, the electrics inside touch-control lamps can. Without a physical switch their electrical circuits are always on, to keep their sensors active, and were found to draw between 0.5 and 1.5W, 24/7, even when 'off'. Lights needing mains adapters to run can also draw electricity when off, unless off at the mains plug. This is because the adapters used to go from mains 240v to 12v or less, are not 100% efficient. No voltage adapters are 100% efficient but some are much more efficient than others.

Two LED lights with adapters, both from IKEA, were compared and their standby usage was very different in terms of efficiency.

Light Type	Standby	On
3m LED strip - multicolour	Less than 0.05W	4.2 to 8.4W (depending on colour chosen)
Under unit LED strip	0.7W	2.0 to 3.7W (depending on number of segments)

Unless you have an energy meter, the only way to tell if an adapter is wasting energy on standby is to feel it. Any energy being wasted will be converted to heat - the warmer one feels the more it is wasting.

Night lights are used to give a low, assistive light during the hours of darkness. As such, they come with sensors to automatically turn off during daylight hours.

Night Light	Standby	On
Tesco NTLD 0.5W	0.5W	0.5W
Integral	0.2W	0.2W

With many bulb types, more energy is used when first turned on – measure as around 5% with halogen, 10% with LED and 25% with fluorescent bulbs. The LEDs settled within 2 minutes; the fluorescents took up to 5 while the halogen bulbs settled within a few seconds. There was no significant change in the tungsten bulbs, which gave a constant reading within a second.

Regardless of the differences between LED types, the technology is such a vast improvement over all previous bulb types the choice of purchase often depends more on design, likely longevity, price and intended use.

For our living-room we have a space-age multi-hoop ceiling light, rated at 25W. Now, 25W, is quite a lot of energy for an LED light and it is much brighter than normally needed but it looks great. As the LEDs are not replaceable it is kept for special occasions, such as when 'the sun' is needed indoors or for a 25th Century feeling.

Night-lights were a surprise. The energy usage by their LED lights is so small, there was no detected power increase when lit. What was different was the amount of energy used, whether lit or not. Tesco claim their unit uses just 0.5W, which it does but all the time, which works out at £2.19 a year.

The Integral one was favoured as it uses just 0.2W; also whether lit or not, costing just 88p a year, 1.7p a week, to run.

Computers: computer power supplies are a special case. When they are turned off at a switch, the next time they are turned on there is a large surge current. This is completely normal but the level of the surge can cause standard 13A wall-plug switches to 'stick' on - the surge having welded the switch contacts together, in the on position. One alternative is to use the switch on the computer's own power supply but an alternative that avoids the risk of wearing this switch out is to use an extension lead fitted with a red, rocker (rocking) switch. These switches are usually rated to 15A and that seemingly small increase is enough for them to much better cope with the surge.

Surge Control

Surge protectors employ one of two devices to diffuse the unwanted voltage. There are two standard ways of doing this: MOV and GDR, both as good as each other and both work by diverting the excess current towards ground, sometimes via the neutral line. The amount of energy they can divert away at any one time is measured in joules – the higher the number the more it can divert. Professional applications can need joule ratings above 1,000. They can be built into extension leads, plug adapters and or even be plug in 'bricks'.

Voltage spikes (brief surges of voltage) can come direct from the National Grid, from thunderstorms and from electrically 'spikey' equipment, such as vacuum cleaners and motorised tools. They tend to be so brief you would need an oscilloscope not a voltage meter to detect them but they are there and they can damage or at least reduce the life of your equipment.

Like most homes, ours has mains ring for sockets on each floor. The one upstairs is protected by an anti-surge multi-socket, the one downstairs by a plug-sized brick in a spare socket.

Not all anti-surge devices are equal and the three main factors are reaction time (m/s milliseconds - lower = better, voltage control (V/volts - lower = better) and energy handling (J/jewels - higher = better).

Wilko's 0315477 plug adapter and 6-way extension lead do not state the specifications on the external packaging; neither do the Status ST-85 extension lead or any other Status brand surge protection products found on sale in Tesco. No technical specifications were found on Wilko or Status websites.

In contrast, Lidl's 8503000342 8-way extension lead, manufactured by ROWI states what voltage levels it can protect against: 2000 to 6000v, depending on the pins it is protecting, for example Live and Neutral or Live and Earth. Masterplug's SRG44N and SRGLSU42PB give even more information. These use not just MOV or GDR protection circuits but both MOV and GDR. Maximum surge current is 12,000 amps for up to 370 joules of energy; with maximum voltage clamped to 925v and a response time below 25ns – that is below just 0.000000025 seconds, which is quick even by Superman standards.

The Micromark MM22256 plug in brick, uses Class 2 protection (8/20 microseconds) coping with up to 7,500v and 9,000 amps, not as good as the Masterplugs but still good.

Make up your own minds as to why Wilko and Status do not quote their technical details. Sadly, since writing this, Wilko has gone bust.

SAVED: £270 a year switching from tungsten to LED bulbs. Calculated as 200W, 8 hours a day, for tungsten (£292) and 15W, 8 hours a day for LED (£21.9).

Star Tips Worth: £270

The sooner you switch your light bulbs to LED the sooner you start saving money.

Chapter 10

Heating

Savings so far: £1,203-1,787

New savings in this chapter: £to be confirmed

Element Types

Traditional electrical heating runs power through heating elements and can be very expensive to run, especially as electricity is over twice the price of gas. These types of heaters including convection, halogen and oil-filled radiators.

To illustrate the difference, running just one, 400W, bar on a halogen heater cost the same per hour (20p) as heating our entire two-bedroom home with its modern condensing gas boiler. If you have no gas supply and rely on electricity to heat your home, there are some excellent alternatives and they can cost the same or even less than gas boilers to run. These are the new generation of heat pumps. Although installing them will still cost £thousands the prices are dropping as they become more common.

Heat Pumps

Heat pumps are nothing new. We have all used them for decades, in our fridges and freezers. The principle is exactly the same: use compression to transfer heat from one place to another. Transfer heat away from a place and you cool it. Transfer heat to a place and you heat it. Basic thermal-dynamics. What is new is the adaptation of this process for home heating and cooling.

<u>Air source</u>

This type of system extracts energy directly from the air. They are the simplest and least expensive to install. However they are the least efficient during winter time and running costs are higher than ground source heat pumps; back up heating is almost always required.

Closed Loop ground source

This type of system uses buried pipe (a slinky) laid horizontally or vertically in trenches 1-2 metres deep to collect energy from the ground. Vertical closed loop systems can also be used but may require multiple boreholes. During extended cold periods and towards the end of winter, the energy extracted reduces as the ground temperature drops; a back up heating system is recommended.

Halogen Bar

If you want to heat just one room, instead of the whole house, is it cheaper to use an electric heater in that one room or gas central heating for the whole home? Out of the five main stand-alone electric heater types - ceramic wire-wound bar, oil-filled radiator, ceramic fan heater, convection and halogen bar - it was considered the halogen gave the best combination of size, efficiency, noise, heat direction and output control; as well as being pleasant to look at with it's sunshine amber warmth. The test halogen item is a fanless, 3 bar, 1200W Beldray. Each 400W bar is identical and can be individually switched on/off - the entire unit set to remain either stationary or quietly rotating, side to side.

Ironically, our living room is the coldest room in the house, as it has just one radiator, at the opposite end to large patio doors. Little heat makes it towards the patio door end, which is also a heat-loss area, even with full-length thermal blinds - open during the day. Question: cheaper to heat the whole house using gas or this one room using the halogen?

Heating method	**Heating area**	**Energy/cost per hour**
Halogen - 1 400W bar	one room	0.4kWh/20p
Halogen - 1 400W bar	one room	0.8kWh/40p
Halogen - 1 400W bar	one room	1.2kWh/60p
Gas central heating	two-bedroom house	1 to 5kWh/8 to 100p

The halogen heater has no thermostat so will run continuously at what ever it is set to. The gas central heating works hard at the beginning then turns itself down/intermittently off as things warm up. After several hours, in a well insulated home, the running cost can drop to just 20p an hour. In practice, in most homes in very cold weather, it is likely to be two or three times higher than that.

Conclusion: for short bursts of localised extra heat, it is less expensive to use the halogen - especially if using it on just one bar. For all day heating of the home, the clear cost winner is the central heating. This would also be expected to apply for central heating using heat pumps.

Star Tips

Heat pumps are the way forward, but not suitable for all homes. One size does not fit all.

The national grid is already struggling to cope with electricity demand - with the increase in electric cars and heating, this will get worse before it gets better.

Gas

Chapter 11

Central Heating

Savings so far: £1,203-1,787

New savings in this chapter: £400 to 600

Condensing Gas Boilers

The UK government suggests dropping central heating boiler temperature to 60 degrees but even set to 65 the living-room radiator here struggles to keep the room warm. It's not faulty in any way, just the last radiator in the circuit so runs the coolest and it is the only one in a large room.

Would dropping the water temperature from 65 to 60 degrees really use less total energy? It's a measurement that will have to wait for winter to find out. It would mean the boiler needing to be on longer to warm the home so would cost more in electricity as the water pump would be on for longer. The hotter something is the faster it will release heat into a room, so heating the room faster in the process and vice versa - the lower the temperature the slower a radiator will release its heat. It's a question of finding a balance and a big part of that balance is ensuring the temperature of the water returning to the boiler does not exceed 57 degrees. Why? Because it would be too hot to condense the exhaust vapour and reclaim the energy in it. In such a case, the condensing boiler would work as a non-condensing boiler, with much lower energy efficiency; see the table below.

Non-Condensing Gas Boiler	Condensing Gas Boiler
60 to 75% efficient	85 to 98% efficient

Condensing boilers have been compulsory boiler types in the UK for some years now so if you have a gas boiler, the chances are it is a condensing one.

If you set your boiler to 85 degrees you will heat your home much faster but there is also a good chance the returning water temperature will be above 57, the exhaust vapour will remain vapour and the heat energy in it will be lost out of the flue. Set it to 70 degrees or below and the temperature of the water returning to the boiler, after going through all the radiators, is probably going to be under 57 degrees, especially when first turned on with cold radiators. As mentioned, the level we use is 65 degrees, as 60 would be too low for the final radiator and mean the living room never gets warm. Set to 65, the final radiator reaches 55 degrees; hot enough to heat the room while ensuring the water that then returns to the boiler from it is always below 57.

As for thermostat temperature, we run ours between 17 and 19 degrees, depending on mood, and just put on a jacket. Upstairs it is around 3 degrees warmer, partly heated by gaming computers. Yes, the heating could be turned up up to 21 or 22 degrees to enable sitting in a T-shirt and shorts but this could double or even treble the heating costs so donning a jacket is deemed a cost=effective compromise.

Test Boilers

1) HE35

The HE35 combi-boiler was kept off at the wall switch unless it was time for a bath or a shower. Why? Because there was no option to turn off the 'comfort/always hot' standby water. If left on the boiler would repeatedly fire up, day and night, regardless of need. Although only a small amount of water was involved, the gas was calculated to cost £75 a year, back in 2014. In today's money that would be closer to £200 a year. If we call it a low average of £100 a year, that is £800 saved over the 8 years before it was replaced.

2) Vaillant

The HE35 combi-boiler was replaced by a Vaillant unit, which does give the option to turn off the standby/comfort 'always hot' small water storage and doing so was the first control change made after installation. The second was to turn down the hot water temperature to 36 degrees for showers and general use; though this is increased to 42 degrees if running a bath. The third thing was to drop the central-heating water temperature from 75 to 65 degrees.

Having no efficiency data for the original HE35 boiler it is not possible to make a fact-based comparison. Subjectively, the new boiler, as with the new fridge-freezer, is noticeably better regulated temperature wise - very noticeable when taking showers. It is also much quieter and it is assumed more energy efficient, though any improvement will be more than offset by the huge increase in the price of gas.

Running costs

When the heating is first put on, the boiler has to warm cold water from cold room temperature, such as 15 degrees, to the pre-set boiler temperature, in our case 65 degrees. That is a 50 degree increase and means full power to begin with, about 5 kW/h in our case. As the water warms, the boiler only needs to add enough heat energy to heat it from the water returning to the boiler temperature. At first this will be low, maybe 30 degrees (a 35 degree increase). As things warm up this return temperature will increase until the final radiator in the cycle gets as hot as it will get on the settings given. Boiler set to 65 degrees, our last radiator gets to a maximum of about 50 degrees, maybe 55 if the heating has been on a long time - reducing the increased heat needed from the boiler from 50 degrees when first turned on to as low as 10 degrees now. For periods of time, the gas needed will drop to zero as the thermostat reaches the required temperature and turns it off. How long it stays off will depend on how fast your home loses heat and how high you have set the temperature to. The higher the setting, the shorter the time the boiler will be off, and vice versa. In any case, per hour, the boiler is working much less hard, using less gas, and reducing the hourly running cost.

Boiler 65, thermostat 19	Hourly Gas Usage	Hourly Cost	Outside temperature
Hour 1	5 kWh	£1.00	11
Hour 2	3.6 kWh	72p	11
Hour 3	2.8 kWh	56p	11
Hour 4 to 20.5	**0.41 kWh**	**8.2p**	**11**

Hours 4 to 20.5 were an 'up to temperature' (19C) usage rate - measured over 16.5 hours overnight, during which time 0.606 cubic metres of gas were used. This converts to 6.75kWh of total gas energy and 0.41kWh of energy per hour. At our 20p per kWh figure, this works out at 8.2p per hour.

This 'up to temperature' cost would be higher if our internal thermostat was set higher than 19 degrees; the outside temperature was lower; our thermal blinds were open and/or our house was less well insulated. As it stands, it compares very well to the one bar halogen heater rate of 0.4kWh of electricity. At our 50p per kWh rate, it makes the one bar heater cost over twice as much, at 20p per hour, for mostly heating just one room.

Heat all the time?

There is the theory that money can be saved by running the central heating continuously, even when no-one is at home. My mum tried it 40 years ago and got shocked by how much it cost in our large, not double-glazed home. However, the better insulation of our modern home indicates, if the heating was to be needed every day, it could potentially be a reasonable thing to do, costing £1.97 per day. Working from cold the system cost £2.28 to run for 3 hours from cold.

Further tests will be carried out over the winter to measure the 'up to temperature' running cost when the outside temperature is lower. It would still be expected to have a working from cold for 3 hours cost to be about £2.28 but a significantly higher than 8.2p per hour consumption rate after that. For the moment at least, the verdict remains out on this.

Two considerations:

1) How long does your home take to warm up to comfortable from cold? Half an hour? An hour? Rather than paying for 8 hours of heating the street, why not set the system to come on half an hour or an hour before you come home instead? Or just accept your home will be a bit chilly at first and turn the heating on when you get home? In both cases you will save the money that would have been spent heating the street while you were out.

2) How much does your heating cost to run when up to temperature? In our case it was measured at 8.2p**.** This will significantly increase (double/treble/more?) when the outside temperature gets even colder - colder outside means faster heat loss from inside.

Caution

Be sure to not let the house temperature drop to the point that pipes might freeze. In winter, the heating can be set to come on automatically if the temperature drops below a chosen minimum, such as 12 degrees.

If you have water pipes, such as for the garden hose, a further precaution can be to ensure the pipe section leading to the outside is empty of water in winter months - there is usually a tap a metre or more inside the home that can turn off the feed and then the outside tap just needs to be opened to release the water in that section of pipe.

Heat Losses

Windows and doors: up to 40%

Remember my childhood home with no double glazing? Mum did add some thin-film 'double glazing' which helped but the house was fundamentally flawed in terms of insulation. Shamefully, many UK homes still do not have double glazing or good insulation and it can cost a fortune to heat.

In the UK, we tend to have radiators under the windows. Traditional, backward thinking to warm any cold air coming from them. In reality it makes them perfectly placed to lose a lot of their heat straight to the outside world. This is why, in Scandinavian countries where it gets far colder than here, they keep radiators well away from windows.

In our current home, even though modern double-glazed, have added thermal roller blinds (£15 to £30 per window/patio), which are rolled down to the carpet or, where there is a radiator, rolled down and tucked behind it - so the rising heat stays inside the room - rather than going to the window. Significant temperature differences can be felt when these blinds are down - the rooms both warm faster and stay warm longer. In the summer the blinds work in reverse - helping to block out the sun and keep rooms cool.

If we owned our home, we would put in triple-glazing with modern, high-tech glass that insulates much better than traditional glass.

Drafts: up to 25%

Drafts are some of the easiest and cheapest heat losses to fix. For as little as £5 a door you can buy a roll of draft excluder and greatly reduce the draft within minutes.

Loft: up to 25 %

The figure of 25% is for when there is no loft insulation. Depending on attic/loft access and floor boarding in it, while significantly more expensive than draft excluders, if there is scope to increase loft insulation (even by DIY) it can make a significant improvement in home insulation.

When it snows, does the snow stay on your roof as long as new-build homes or does it quickly melt? New builds are supposed to have good insulation so they can be good bench-marks for comparison.

Walls: up to 35%

Cavity-wall insulation can be 4-figure expensive and is not a DIY job. There are many different types and which ever type you are thinking of, make sure your mortgage and home insurance companies approve it. Use one they do not approve of and it is a serious issues, for once cavity-wall insulation is in it is almost impossible to take out. A bad type of cavity-wall insulation can trap moisture - causing damage from the inside out.

Exterior cladding can be added instead, though we all know the potential consequences of using the wrong type of cladding, after the totally avoidable horror of Grenfell Tower. The price difference between a safe and the unsafe cladding used was minimal. The price difference in human life was massive.

SAVED £400: 10% by adding thermal blinds and another 50% by turning the boiler down to 65 degrees and, more crucially, the air-temperature thermostat to just 17 or 18 degrees or totally off during the day and 16 degrees or totally off at night. Warm duvet's and indoor jackets are one-off purchases. With an annual heating bill of around £400, it would be £800 if the boiler was used more and another £80 or more if there were no thermal blinds. Without the thermal blinds the temperature drop would more often go below 17 degrees, needing the boiler to be on more than another 10% of the time. In the worst case, the saving is £400 (£80 to cover the cost of blinds, duvets and jackets), at best it is over £600.

Star Tips Worth: £400+

Cut draughts. Use thermal blinds. Have boiler set to no more than 65c.
Have shower water set to no more than 35c
Have heating thermostat set as low as comfortable. When not home only use enough heating to prevent burst pipes and warm pets.

Chapter 12

Cooking - 2

Savings so far: £1,603-2,387

New savings in this chapter: £705

Gas Hob

This unbranded gas cooker hob has four gas rings; 55mm, 71.5mm (x2) and 101mm in diameter. To try and calculate the different heat capability of each ring two things were measured:

1) The area of rings, which came to 2000, 4000 and 8000 mm2.

2) The area of the gas feed hole in the ring centre, which came to about 32, 70 and 254mm2.

It is probably industry standard size reasons for the rings to go in clear doubling steps. However, the gas-feed hole, indicating the maximum amount of gas sent to the ring, roughly doubles from small (32) to medium (70) but then jumps almost 4-fold to the large (254).

How Much to Run?

The amount of gas used by each ring was measured and converted it to kWh; using 1 m3 = 11.136 kWh), at 20p kWh.

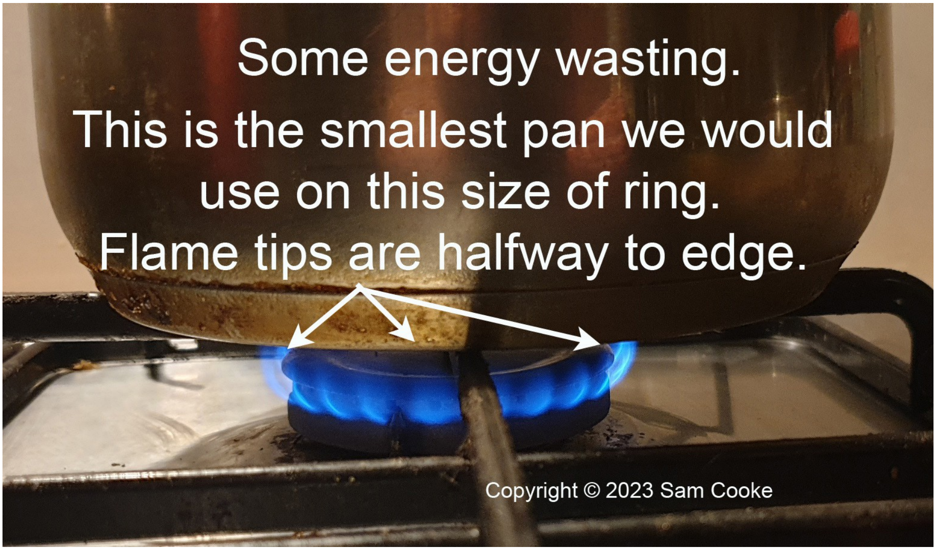
Ring size	Minimum	Maximum
55mm	0.223 kWh (4.5p)	0.423 kWh (8.5p)
71.5mm	0.445 kWh (8.9p)	TBC
101mm	0.710 kWh (14.2p)	TBC

Improving Efficiency

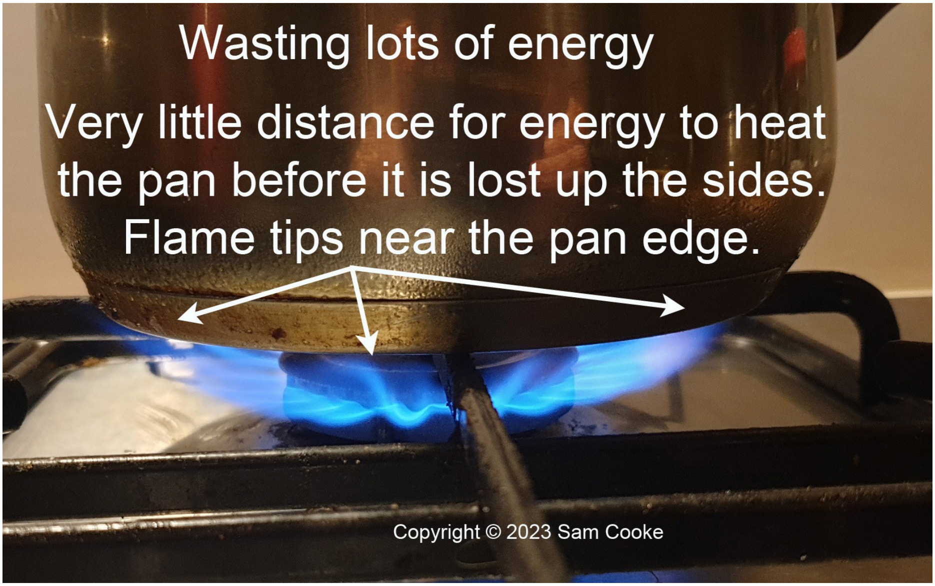
Pan and flame ring size

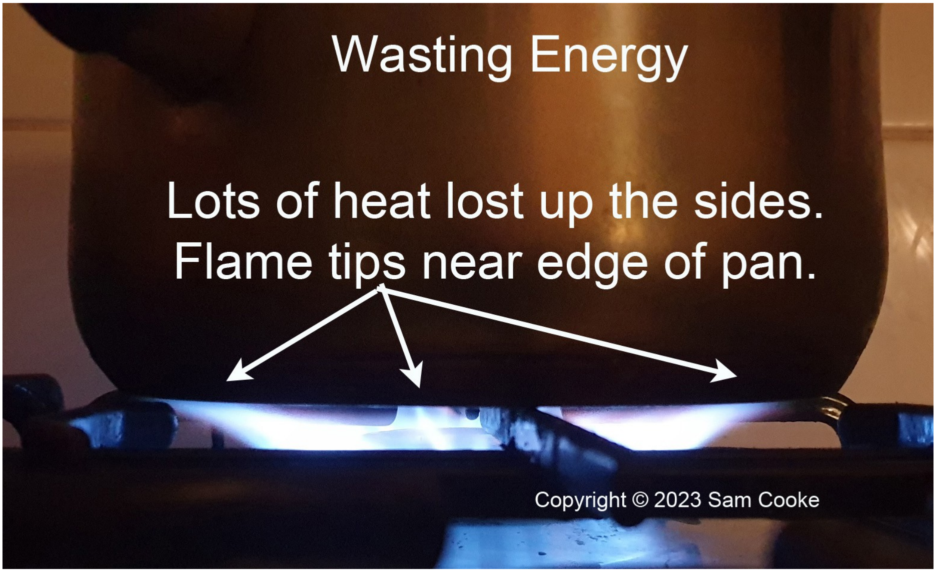
Gas hobs mostly heat by contact with the flame (conduction) and hot air rising (convection then conduction). The greatest heat is near the flame tip - which is why gas welders and braziers point the flame tip at the material to be melted. Around the flame the air will get hot and this heat goes up the the pan base then along it towards the edges, where it goes up the sides. The further this heat has to travel under the pan the more energy it can pass into the pan. Below is an example of the smallest ring heating a large pan, showing how close to the middle and away from the edges the flame tips are.

Below is an example of a medium ring being used on a medium-sized pan. Note the flame is on low to keep the flame tips away from the edges.



In the next example, below, you can see the flame tips are right at the edge of the pan - meaning a huge amount of the heat is lost straight up the sides.





Above is another view of energy wasting by having the flame tips near the edge of the pan. Great for heating the kitchen in winter - not so great at putting the heat into the pan.

With the gas down low, the flame ring is about 5mm wider than the physical ring, regardless of ring size. For example, the 55mm diameter ring would have a flame ring of about 65mm (55+5+5mm). Turned up high, it grows to around 75mm. Larger rings grow more - you only need to look under your pans to see how much the flame ring grows towards the edge as you turn the gas up.

55mm	**Flame ring**	**16cm pan**	**20cm pan**	**24cm pan**
low	65mm	47mm travel	67mm travel	87mm travel
high	75mm	42mm travel	62mm travel	82mm travel
71mm	**Flame ring**	**16cm pan**	**20cm pan**	**24cm pan**
low	80mm	40mm travel	60mm travel	80mm travel
high	100mm	30mm travel	50mm travel	60mm travel

This difference in energy efficiency due to heat travel, or lack of, can be so pronounced that moving a boiling 20cm pan of vegetables from the 71mm ring to the 55mm ring on low, it continues to boil – despite the 50% lower gas usage.

Tip: try to have the flame ring at least an inch or two (3 to 5cm) from the pan edges. To see where the heat transfers into a pan, crack a few eggs into a frying pan and see where the eggs start whiting first, indicating the most heated area. Try this with the same frying pan on different ring sizes or even different sized frying pans on the same ring, even using different flame settings. A great way to get a visual understanding of how the heat spreads.

Unless deliberately letting food crisp/dry, all cooking is done with lids on the pans; which leads to the next section.

Lids

When ever possible, use one. Not only will the amount of steam produced be greatly reduced that steam is boiled off water – which is a huge loss of heat energy. In the same way a condensing boiler recycles vapour energy to improve efficiency, using lids does the same thing. The hot vapour returns to the liquid, along with the heat in it. Let it escape as steam and all that energy is lost.

To illustrate this, keeping a 20cm saucepan of water boiling without a lid needed the 71mm ring to be turned to at least half power. To keep the same saucepan of water boiling with a lid on, the 55mm ring on minimum was more than enough; using a three to four times less energy.

When cooking the fish fingers in the frying pan, a lid was used fully for the first 10 minutes and then slightly 'ajar' for the next 10 minutes, to allow them to crisp up and not be soggy. For the final minute the lid was completely off.

SAVED: 75% by using lids. When boiling water converts to steam it takes a huge amount of heat away with it. By using a lid, most of that steam condenses on the lid and drops back into the pan, returning most of its heat energy to it.

Liquid based contents

Boiling vegetables, soups, pasta, rice, etc

When you have a high liquid content the heat is able to spread throughout the pan by natural convection currents. With a lid on, it takes a surprisingly small ring and small flame to maintain a boil.

Dry or shallow oil based contents

Sausages, eggs, chicken nuggets, fish fingers, burgers, etc

Here the main cooking is through conduction, into the bottom surface of the item(s) being cooked. Using lids still reduces heat loss and helps the whole pan to heat up and heat the food above the base. Caution: the steam that will condense on the inside of the lid, can run off into the hot oil when lifted - causing spitting.

As the oil doesn't turn to steam the way water does and because most heat energy is going into the food by conduction, there is potentially less heat loss if not using a lid than with boiling water; however, as water still comes out of cooking food the energy this loses as steam is still energy a lid could have returned to the cook. To ensure food, for example fish fingers and chicken nuggets, are crispy when done, simply partially or fully remove the lid near the end of the cook to let it dry out.

Meal Time Costs?

Test One - partially defrosted

The gas hob was used to cook 1.6kg of chicken breast, from part frozen, 1.2kg of fridge temperature potatoes (including 2cm deep water in the pan), 1.8kg (including full pan of water) of fridge temperature vegetables and 1.3kg of gravy.

On the smallest ring, on high, the chicken was started in a 28cm pan, lid on. After about 45 mins, the 22cm potato and 20cm vegetable pans were started on the middle-sized rings, on low - both with lids on. In the space between the three pans, the 16cm gravy pan, with initial contents (gravy mix and cornflower mixed into a thin paste) inside, was placed adjacent to the other pans - to get pre-warmed by their close proximity. Once the vegetables were boiling the now cooked chicken, lid still on to retain heat, was moved to a rear ring (off), potatoes now also off, also lid still on, they were finished on the small ring and then moved aside for the gravy pan to go on the small ring - boiling vegetable water added to it; gravy brought to boil in few minutes and job done.

Total gas usage? 0.126 cubic metres, which is 1.4kWh of gas, costing 28p.

Even if the same meal could have been cooked using the same amount of electrical energy the cost would have been 70p, due to the greater cost of electricity per kWh.

Test Two - fully defrosted

Similar process to the above but this time the chicken was fully defrosted and there was less of it. Again, using four pans, the fourth only used for gravy once the vegetable pan had finished, a full meal was cooked using two medium and the small hob ring. This meal consisted of 1kg of chicken breast, 1.5kg (including 2cm depth of water) of room temperature potatoes, 1.8kg (including full pan of water) of room temperature vegetables, which was drained off to make the 1.5kg (1.3 litres) of gravy after they were cooked. The chicken breast was almost falling apart soft, the potatoes soft enough to mash with ease (green pesto added) and the vegetables (fresh broccoli and carrots) cooked to lightly soft. From start to finish, the entire meal took 1 hour and 15 minutes to cook and used 0.0965 cubic metres of gas; the equivalent of 1.07 kWh of energy and 21.5p in cost. What could you cook using 21.5p of electricity? Not three plates of this:

One of the three, equal-sized, adult meals - filling full-sized 27 cm plates - for just 21.5p in gas energy. On the next page is another cook, this time using a 32cm frying pan with sausages.


HAMMERITE
METAL PAINT
Almost cooked
Copyright © Sam Cooke 2003


Cooked - one of three
Copyright © Sam Cooke 2003

Another three adult meals, again on 27cm plates, cooked using 0.157 cubic metres of gas, 1.748 kWh of energy, costing 35p. Cooking time was 1 hour and 30 minutes, with all flames on minimum. Using larger flames it could have easily been cooked in half that time but at greater cost – as this book is about saving you energy money the focus is on energy efficiency.

What could be cooked for 21.5p, 28p or even 35p of electricity? Certainly not three plates of the full meals above.

	Electric Air-Fryer	**Gas Hob**
6 fish fingers (frozen)	11.6p	3.1p

Even cooking fish fingers in a 28cm pan on the gas hob is 3.7 times cheaper than the air-fryer so 3.7 times cheaper is the saving figure we are going to use for an annual gas cooking spend of £150. This gas bill would be at least £450 if lids were not used. To be fair to air-fryers and ovens, things like fish-fingers and chips are much nicer when cooked in one. Worth the extra cost? We think so.

SAVED: £300 or more by cooking with lids.
SAVED: another £405 **(**£555 - 150**)** by cooking mostly on gas, six days a week, with lids on the pans, even when making fried eggs, almost always on minimum heat. **TOTAL: £705**

Final Conclusions

What ever type of cooker options are available, how they are used can have a great influence on the cost. Cooking from fridge temperature instead of from frozen and using lids can both bring great savings, whether cooking with gas or electricity.

The total savings made for the devices on test ranged between £2,308 and £3,092, with no impact on living style and no 'smart' meters.

Star Tips Worth: £700+

Use lids on pans. Use pans big enough not to have flames near the edges. Use smallest hobs able to put enough heat into the pan. Avoid cooking from frozen. Gas energy costs less than half that of electric.

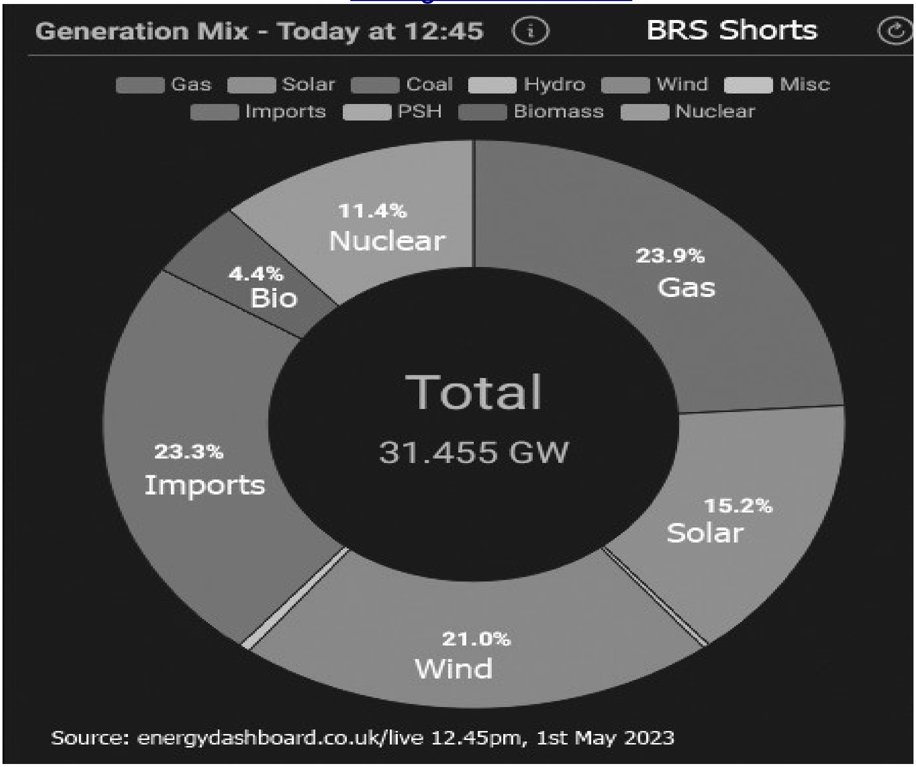
Energy Production

Chapter 13

Energy Options

No guide on energy costs would be complete without some mention of how energy is sourced, the costs involved and potential green ways forward. After all, how are electric cars and heat-pumps going to improve our country's green credentials if the electricity from the National Grid itself is not actually green? Let's take a look at the UK's electricity production right now, from www.energydashboard.co.uk/live this lunchtime:

An alternative source is www.gridwatch.co.uk/ which seems an hour



behind in its information, hence the choice to quote energy dashboard numbers.

As a mild, slightly cloudy day with medium demand, no coal stations are contributing to the energy as the moment. Nuclear is running at 11.4% and gas at 23.9%. Only 36.2% produced by the truly green methods of wind and solar. We have no details on what is generating the 23.3% we are importing from Holland (11.8%), France (5%), Belgium (4.3%) or Norway (0.3%) but the energy from Holland is creating 474gCO2/kWh which is high, even for gas. In contrast, the energy from Norway is Nuclear, while labelled green as it does not generate greenhouse gases when running, is not. How many tons of CO2 are produced during construction, decommissioning and storage of radioactive waste.

With holistic views in mind, I've listed the different types of energy production in order of desirability, based on our understanding of true environmental impact and cost to design, build, run and clean-up afterwards. We haven't included hydro-electric power as building such things is very much limited by their geological requirements.

Energy Cartels

The way the global energy system is run means even if the UK generated all its electricity cheaply, we would still be paying the global rate, currently £75/MWh (it spiked to almost £600/MWh after Putin's invasion of Ukraine). The cost of electricity generated by solar and wind is currently £50/MWh and falling but, thanks to the cartel system, we still pay the global rate.

While the cost of wind and solar energy is becoming ever cheaper, the cost of nuclear energy only seems to go up – Hinkley Point is set to cost £106/MWh, if it ever gets turned on.

A dull, rainy day today and solar output has dropped to 5% of demand. Gas remains the highest at 29%, followed by wind at 22% and nuclear at 15%.

Drilling for new UK oil to support the UK energy market? It won't and even those saying it will know it won't. We can't refine it in the UK and it will go straight to the international not UK supply chain. What it will do is ensure extra big profits for the oil companies and their willingness to support officials enabling them to do so. Won't affect the UK 2050 net zero target? How? By more Green-washing? Just ask Greta Thunburg for details on what that really means.

The following prices are for indications only and subject to change – for wind and solar that change is always downwards.

1) Wind power - 5 to 25% of UK energy

£48/MWh

In the UK, an ironic benefit of global warming is increased wind strength for wind farms. Some argue against more on-shore wind farms, due to the impact on landscape views and birdlife – both of which need consideration, on a case by case basis. Off-shore wind farms, of which the UK now has one of the largest in Europe, are more expensive to build and maintain but cause less 'harm' to views and wildlife. Off-shore there are also stronger winds; sometimes too strong. However, if there is low energy production due to a low wind day, there is currently an argument for keeping gas/coal power stations online as back-ups but this could be avoided if excess energy was used for hydrogen production.

With green hydrogen production: Canada are world leaders in hydrogen as a clean fuel. They have made a big push for using it, as it burns without pollution or greenhouse gases and can be made simply by combining electricity and water, in a simple process called hydrolysis. The UK could easily do the same, using the excess electricity generated on windy days to generate hydrogen as a back-up fuel for clean electricity on low wind days. Even without modifications, gas power stations can have 20% hydrogen added - which would reduce our gas needs and pollution from gas by 20%. Even domestic gas boilers and cookers can run on a 20% hydrogen mix, again without any modifications. At a stroke, it would mean a UK-wide 20% reduction on dependence for natural gas. You can be sure the energy companies know this - you can guess for yourselves why they don't mention it.

2) Solar power - 0 to 20% of UK energy

£50/MWh

NIMBY's aside, arguments against on-shore solar farms have been in defence of farming land lost to them. This alone, makes it almost criminal that government initiatives to help put solar panels on homes and other existing roof-spaces, effectively otherwise wasted space, was cut.

Not all solar panels are equal. Crystalline polysilicon is by far the most common but higher efficiency monocrystalline wafers and even better technology is already hitting the market.

Along with differences in panel technology, in France they have successfully trialled solar panels suspended above fields on a cable system. This brilliant system allows crops/livestock to operate below the solar panels as normal. The even more clever bit is these panels are mounted on a computer-controlled moveable cable system, where the panels can be rotated horizontally to shield the land from excess sun or storms, vertically to allow maximum rain to reach the soil, if desired, and even to adjust their angle to follow the angle of the sun during the day – maximising electricity output. Very clever and very effective.

With green hydrogen production: As with wind power, with hydrogen production, with solar the need is for back up during dark days and at night. The process of generating green hydrogen for energy back up from excess energy days would be exactly the same as for wind.

3) Green hydrogen - 0% of UK energy

£?/MWh

There are too many unknowns to give an accurate price for green hydrogen production in the UK as nobody seems to be doing it.

Hydrogen is a colourless gas, which is made by splitting water into oxygen and hydrogen. Both hydrogen and oxygen be stored in liquid form (if compressed and cooled to around minus 250 degrees centigrade). The only things hydrogen generates when burnt are heat and water, nothing else - zero greenhouse gases.

Power stations, potentially converted gas power stations, running on 100% hydrogen would bring all the benefits of natural gas with none of the pollutions from it or how it is obtained. Even some car manufacturers, including Hyundai, Toyota, BMW and Honda, are developing hydrogen powered cars as alternatives to electric ones. Hyundai and Toyota both have hydrogen powered cars on sale right now. Sadly, as green hydrogen is not available in the UK, they will be running on grey hydrogen – produced using fossil-fuels.

Confusingly, there are many different colour designations for hydrogen (green, yellow, blue, grey) but don't be confused - these only relate to how it was produced not the hydrogen itself. From an environmental point of view, the hydrogen we are interested in here is green hydrogen, generated using solar or wind.

4) Natural Gas – 20 to 40% of UK energy

£200-6,000/MWh

No, £6,000 is not a typo. It is reported, in the Guardian, that Rye House power station in Hertfordshire was paid £6,000/MWh in December 2022. Gas remains the least polluting of fossil fuels and can be made 20% cleaner by adding 20% hydrogen to it. Although it would still be 80% fossil fuel, this would be a good, cheap, quick step in the right direction, as well as reducing our need for gas imports. Still not green though and natural gas is destined to be consigned to the history books. Let's hope the gas powered generators are converted to run on 100% green hydrogen rather than just being scrapped.

5) Wave/Fusion - 0% of UK energy

£?/MWh

These are greenhouse-free energies when running, with no bad waste issues, both of which have yet to achieve their potential. Wave power has been around for decades and have yet to hear of any commercially viable generation.

Power from nuclear fusion remains more of a scientific challenge and financial black-hole than viable energy source. Even when (when, not if) it is achieved will the amount of pollution generated building such power sources make them more viable than wind, solar or hydrogen? I doubt it. Once achieved, fusion is unlikely to become the best power source for the National Grid but it could become so for things like large cargo ships. The science is fascinating and in many ways it is like the space race, where previously unthought of needs create all sorts of inventions and products along the way. For now our assertion is that, wind and solar, ideally with hydrogen generation, remain the best, most cost effective and truly green options.

6) Nuclear - 10 to 15% of UK energy

£100+/MWh

Nuclear energy is not green. That is not a typo and I'll say it again: nuclear energy is not green. No it doesn't put out greenhouse gasses while generating energy there is the greenhouse pollution generated during the construction of nuclear power plants and during the transportation, processing and storage of the many tons of nuclear waste, which actually creates a very long-term environmental nightmare. At any time, each large nuclear reactor contains 50 tons of enriched uranium.

Massive costs: not just the £10 to 20+ billion needed to build the power stations but also the production/running costs of 50 tons of enriched uranium, then the processing and storing of the radioactive waste – not for decades but for hundreds, possibly thousands of years. The Nuclear Decommissioning Authority (NDA) puts the current cost at £3 billion a year, £2 billion a year of which is funded directly by us, as tax-payers. The other £1 billion is covered by the NDA itself but that is still £1 billion that could go elsewhere. How many wind/solar farms could £1 billion build? At today's prices, which are going down, we could be getting around 1250MW from solar. Hinkley Point is set to cost over £23 billion and designed to generate 3,200MW. **For £23 billion on solar we could get 28,750MW.**

Environmental risk: Sensitive medical steel has had to be sourced from sunken ships from WW2. Why? Because since the atomic bomb at Hiroshima and other nuclear tests/accidents, the amount of radiation in the atmosphere I breathe has increased to the point that steels made today, due to the amount of air needed to produce steel, makes it too radioactive for sensitive instruments.

It only takes one big accident, like another Fukushima or Chernobyl to name just two, for a new level of global pollution to take place. I can't see, smell or feel the radiation but it stays in our environment for centuries, possibly millennia. Unlike other pollutants, it doesn't break down and fade away but accumulates in the land and sea. For sensitive instruments, the UK has been taking steel from pre-radiation WW2 ship-wrecks in Scapa Flow, Scotland. Little could the German commander have known how much scuttling his fleet would serve to help us after the war.

If I only consider the greenhouse gases generated once a nuclear power station has been built and is running, I could, and many do, claim it is green energy. Looking at the bigger picture, of build, radiation refinement and nuclear waste care, they are clearly anything but green and, in the long-term, financial black holes.

Commissioning: Given the above, why are some ministers so keen on nuclear? Our ministers approving power station facilities appear to have complete ignorance what they are are actually approving – which makes no sense given the money spent considering such proposals and the number of advisors involved. Even I, a simple engineer, researcher and writer, can see the issues. Hinkley Point is an EPR design, funded by France's EDF and China's CGN (CGN have been sanctioned by the US as an espionage risk) but were given the green light by the UK government in 2016 – inspiring the book *'Nuclear – bursting point'*, available on *Amazon*

As far as nuclear power goes, EPR designs are widely regarded as technically brilliant but literally impossible to build to the design specifications. In France, a major nuclear user and exporter, nine of their 65 nuclear reactors are not running, including every EPR design. In July 2023, 14 years behind schedule and at a cost of over £10 billion, Finland's Olkiluoto reactor 3, a 1,600MW EPR reactor, finally came online – so delayed the country abandoned the build of a second EPR reactor. **For this 1,600 MW EPR reactor's £10 billion the Finns could have built 12,500MW of solar farms.** The only other place in the world where EPR reactors are actually operating are the two in Taishan, China – and they hit difficulties shortly after going online in 2018.

Given this very widely available information of the commercial non-viability of nuclear reactors, what has been the UK government's response in 2022? To order more EPR reactors. Is not the definition of stupidity the act of repeating the same thing and expecting a different outcome?

War: look at what has happened in Ukraine, with the Russians shelling close to Europe's largest nuclear power station site, with six nuclear reactors. While the reinforced concrete walls of nuclear reactors are up to three metres thick, able to withstand even a direct hit by most shells, their vital support infrastructure is not. A single shell into a cooling building could put a reactor into meltdown; potentially creating a new nuclear disaster in Europe. France, with its vast number of nuclear reactors, has made itself a 'dirty bomb heaven' in the case of both war and terrorist attack.

De-commissioning: The Nuclear Decommissioning Authority (NDA) estimates the clean-up of our old nuclear sites will cost a further £132 billion over 120 years, with current costs of around £3 billion a year. For that £3 billion we could be building 3,750MW of solar farms, every year, with zero waste costs. Think about it.

8) Coal - 0 to 2.5% of UK energy

The dirtiest and most immediately polluting of all our global warming, fossil-fuel power stations. The level of pollution can be significantly affected by the type of coal burnt but it remains totally shameful I are still dependent on any coal for our electricity generation. Thankfully the 2.5% of UK electricity generation is 0% on warmer days and set to be totally phased out by 2025.

Coking coal remains important for steel production, with our strategically critical steel industry under serious threat from short-sighted UK politics and long-term strategic planning by the foreign governments actively working to decimate it.

Glossary

Terms used in this book

Billion - the American international version of billion is used: 1,000 x million, rather than the traditional million x million.

Boiling point - the temperature at which water (pure) boils at 1 atmosphere of pressure - 100 degrees centigrade (C).

Degrees - the temperature of something in degrees centigrade (Celsius), as opposed to Fahrenheit or Kelvin

Energy rating label - if an old-scale energy rating is being quoted it will be referred to as 'old -rating'. If quoting a new-scale energy rating it will simply be referred to as '-rating'.

Freezing point - the temperature at which (pure) water freezes, at 1 atmosphere of pressure - 0 degrees centigrade (C).

Gigawatt (GW) - a billion Watts (1,000,000,000)

'Hard' turned off - a device that is physically switched off, often at a plug, or even unplugged. In this state devices can not be 'woken' by a remote control. Examples: ceiling lights, kettles, ovens, vacuum cleaners and any device with the power physically disconnected.

Hard disk - a generic term used for a computer storage device that stores the data when powered off. Originally these were, and many large capacity ones still are, built with spinning discs read by heads, coming in 3.5” (desktop) and 2.5” (laptop) physical sizes. Solid State Drives (SSDs) perform the same function but without any moving parts. Modern SSDs are becoming very reliable and can be significantly faster than traditional hard disks - especially at accessing multiple small files.

High-capacitance device - a device that needs smooth, internal electricity for its circuits and uses large capacitors (energy reserves) to aid this. It is these capacitors that are supplying energy to a device for a few seconds after it is turned off - which is why it can take a few seconds for power indicators to go out as the capacitors empty. It is these, now empty, capacitors suddenly filling that causes a power surge across physical switches when turning on - and why 13amp wall plug switches can eventually 'stick' on, as their metal contacts get welded together by the surge. Which is why we use multi-sockets with a 15amp switch; usually a red illuminated rocker switch.

High load device - a device that demands a sudden high load (500W plus) of power, usually for a motor (vacuum cleaner, lawn mower, power tool, etc) or a heating element (kettle, oven, washing machine heating, etc).

Kilowatt (KW) - a thousand Watts (1,000)

Kilowatt hour (KWh) - a thousand Watts for an hour

Lumen (lm) - standard measurement of light output brightness.

Milliwatt (mW) - a thousandth of a watt (0.001)

Megawatt (MW) - a million Watts (1,000,000)

'Soft' turned off - a device that is turned off via an electrical circuit but is not entirely off. In this state devices can be 'woken' by a remote control, such as a TV, or a button, such as a computer.

SSD - Solid State Drive, a faster alternative to a traditional hard disk, with no moving parts. These come in 2.5”/1.5” and M1/M2 formats. While an SSD can generically be called a hard disk, a hard disk cannot be called an SSD.

'Standby' - the same as 'soft' turned off.

'Surge' - a rush of electricity, caused either by a mains supply surge (voltage spike) or when turning on a high capacitance device (music system, computer, etc) or a high load device (kettle, hoover, etc.)

Volt (v) - standard energy measurement, defined by a 1 amp load using 1 watt of power. In the UK standard mains voltage is 240v, give or take 10v. In the US it is 110v, give or take 10v.

Volt/amp/watt - the relationship of these can be thought of in terms of water in a pipe: **volts =** the water pressure; **amps =** the pipe capacity (diameter); **watts =** the energy of flowing water, as combination of capacity (diameter) and pressure force.

Watt (W) - standard energy measurement, defined by one joule of energy per second

Unit cost of electricity - the cost of one KWh - figure used here is 50p

Unit cost of gas (converted to KWh) - the cost of one KWh - figure used here is 20p

From the Author

It is amazing how misconceptions can stick in our minds, often for the wrong reasons. Take Milton Keynes (MK), for example. My first knowledge of MK was a television advert featuring their concrete cows. What stuck in my mind? Concrete. It made me, and many others, think of MK as a grey, concrete jungle - yet the reality is totally different. Over a million trees, large parks and lakes, lots of greenery and outdoor spaces for young and old alike. They even filmed a Christopher Reeve Superman film, flying across the mirrored-glass frontage of MK's train station.

Another misconception is that nuclear energy is green. Yes, the power stations themselves do not generate greenhouse gases while producing electricity but that is where their green credentials end. Building nuclear power stations is massively polluting but that's not the worst part – dealing with the radioactive waste is. It can't just be popped into a tin can or a concrete bunker, it has to be stored in an environment that is geologically stable for millions of years, with regular monitoring/repackaging, or have countless £millions spent - in energy, money and effort - processing it to reduce the radiation and reduce the storage time to maybe just a few hundred or thousand years. Who pays for all that? Us, of course. And the environment.

Until our government takes an educated, long-term holistic approach to energy stability and production, we are never going to enjoy the cheap, stable green electricity our country could so easily be enjoying. Why do ministers rely on fossil-fuel companies to find us green ways forward? Why are these fossil fuel companies being given more in tax-payer subsidies than it would cost to build solar, wind and hydrogen alternatives? No matter how much these companies say they will - it's against their commercial interests to do anything truly green. They could have done it years ago but still haven't. Not holding my breath...