Do-it-Yourself : Saving the Planet

2. Reducing the Cost

2.0 Introduction
If you've succeeded in getting some credible numbers for your emissions caused by your use of gas, electricity, petrol, diesel and by your flying, the next step is to consider what the numbers are telling you. If one is much bigger than the others, that will naturally focus attention on that aspect. If none dominates then I guess you might possibly want to use my numbers as a reference.

If one of my numbers is much lower, that might suggest that there are things you could do to reduce yours. I say ***might*** suggest. A reason it might not is that we might not be doing an apples with apples comparison. For example, our house has a shower that runs off the hot water system and that water is heated by gas. If your shower is electric, then your electricity use is likely to be more than mine but your gas lower. One is not necessarily better than the other; they are just different.

However, if your numbers are much lower than mine, I'd be interested to hear how you are achieving it.

Whatever conclusions you draw, you might look at the sections below which try to give some ideas on what to look for and what might be done.

2.1 Gas
2.1.1 Basic Efficiency
Most houses in Verwood are of an age such that they have cavity walls and probably already have cavity wall insulation, 300mm loft insulation, 40mm double glazing and a condensing boiler. The first step is to check that this is actually true of our own houses and, if it is not, consider upgrading to this standard. Of these four items, probably the most expensive and the least effective is double glazing, especially so if the existing windows are already some sort of double glazing. Obviously any work should only be undertaken after taking proper advice and be done by a reputable company.

When we moved in, our house was up to this standard except for the loft insulation which was only 100mm thick. By measuring our gas use

before and after upgrading the insulation and correlating this with met office weather data, I concluded that this reduced our gas use by 9.5%. One small step for mankind.

Once this basic standard of insulation is reached, the question is what do we do next?

2.1.1 Floors

Some houses in Verwood (ours included) have uninsulated, suspended, wooden floors. These are a significant cause of heat loss and there is a now a relatively painless way of insulating them. A hatch is cut in the floor and then a little rover is driven around the void below spraying a foam insulation onto the underside of the floor. If it were not for Covid, we might have had this done. I have discussed this with a firm that does this but haven't yet got all of the reassurance I was looking for concerning the fire resistance of the foam.

Many other houses will have uninsulated, solid floors. These are not such a problem and doing anything to improve them is much more difficult so this is unlikely to be a viable course of action unless the house is your hobby, you would just love underfloor heating and don't mind spending a lot of money.

This takes us to the position that houses are as well insulated as they can reasonably be and their boilers are as efficient as they can reasonably be. There are then two possible ways forward from here.

2.1.2 The Hydrogen Economy

The first case, we just sit back and wait for the government and energy industry to change the gas mains from supplying natural gas to supplying hydrogen. There are two ways of generating the required hydrogen. The first is to react natural gas with steam to produce hydrogen and CO2, separating them and then storing the CO2 in depleted natural gas reservoirs. The other is to use nuclear, wind or solar generated electricity to split water into hydrogen and oxygen. Both of these approaches are technically viable and are recommended by official government bodies. This does not mean however that they are likely to happen any time soon or, judging by past experience, ever. Even if a decision is made, it may be to close down the gas network. Thus it may well be that, if you choose this method, you are actually deciding to do nothing.

2.1.3 Heat Pumps

The second way is to fit a heat pump such as the ultra quiet Ecodan. This is an electrically powered box with a fan that sits outside your house and extracts heat from the air. It then supplies warm water to heat radiators in the house in the normal way. The key feature of heat pumps is that the heat energy output is more (maybe 4 times more) than the electrical energy input and thus they can reduce emissions even if the electricity is generated by burning fossil fuel. The advantage here is that we are not dependent on government or any other organisation. The ultra quiet Ecodans don't even need planning permission so you can just go ahead and do it. I have spoken to a plumber in Verwood who has experience of them.

It is not of course quite as easy this makes it sound. The fundamental laws of physics dictate that hotter the water being produced the lower the heat pump's efficiency. In order to be able to keep the water temperature down, more effective radiators are required. In our house, we would have to replace the larger radiators with fan assisted radiators and use these displaced radiators to replace the smaller ones. There would thus be significant plumbing and possibly redecorating jobs to be done. It is thus not a cheap thing to do but there are grants and payments available.

The reduction of CO2 emissions caused by installing a heat pump is not easy to establish. This is partly because the Ecodan data sheets are vague as to how their performance varies with the ambient temperature and partly because estimating how much extra CO2 the generating system will emit when meeting the extra electricity demand created by heat pumps is tricky. I'll perhaps cover this subject later. You would however expect a reduction in emissions and, if more low emission electricity generating stations continue to be built, you would expect big reductions.

A word of caution here. With a heat pump you are changing from buying gas to heat your home to buying electricity. Electricity however is much more expensive for a given energy value than gas. This is hopefully made up for by heat pump's much greater efficiency but the advice I have received is that you really need to be well insulated before you install a heat pump as otherwise you won't like the size of the electricity bills.

2.2 Electricity

2.2.1 Basic appliance audit

The first step is to do a basic audit of your major appliances… oven, hob (if electric), washing machine, tumble drier, fridge/freezer and dishwasher. If you still have their paperwork, you can look up the official EU energy efficiency rating. If you can't find the paperwork, putting the model number into an internet search should give the information without too much trouble. If the washing machine is rated as 'AAA', the freezer as 'A+' and the others as 'A' then they are about as good as you can get. If they have lower ratings, you have the opportunity to reduce your emissions by replacing them with better machines at an opportune moment. Immediately rushing out and replacing them probably isn't the best thing for either your wallet or the planet. There are considerable emissions associated with the manufacture of appliances and thus you want to buy appliances as infrequently as possible.

The plan I adopted was to buy Miele appliances because they were designed to last 20 years and they undertook to supply parts for at least 20 years. They were not cheap but, on the basis that one washing machine that lasts 20 years is cheaper in the long run than 3 that last 7 years, I would not loose out financially. It's also a fair bet that 1 well made washing machine has less manufacturing emissions than 3 cheap ones. I actually bought the washing machine when the previous one was old and obviously near the end of its life and there was an offer of a free 10 year guarantee on new machines. This proved to be a good deal. It failed recently at 9 years old and was repaired free of charge.

Similarly I bought an 'A' rated, heat pump tumble drier when there was a special offer… £111 off because Miele was 111 years old. 'A' rated tumble driers are expensive to buy but the objective here is to reduce CO2 emissions not to save money but, in any event, calculation showed that it would pay for itself financially eventually because of the lower electricity costs.

2.2.2 Lights audit

In the case of light bulbs, you almost certainly haven't kept the paperwork but we are only interested in their basic technology… incandescent filament, fluorescent or LED. This can be determined by looking at them or looking at the wattage rating printed on them. A 13 watt LED lamp produces rather more light than a 22 watt fluorescent and as much as a 100 watt incandescent. LED's also come on immediately at full brightness and with the correct colour.

There is not much to be gained by replacing bulbs that are hardly ever used. I still have an incandescent bulb in the attic. It's switched on for about 10 minutes a year. I also still have fluorescents in the garage, bedside tables and other low use settings. All the high use areas however now have LED's. At about £5 a bulb, the costs involved small.

I bought Philips, A+ rated, non dimmable, pearl bulbs in a variety of sizes. I bought Philips on the grounds that, if they can't make them, no one can. A couple in the first batch failed early on but after that there has been no trouble and they work just fine. If you have no experience of LED bulbs, I'd advise buying just a couple to start with. Their brightness can be a surprise.

If you have long fluorescent tubes in places where they are used a lot (eg a kitchen), they can be replaced by LED fluorescent tube lookalikes. You need to know the physical length and diameter of the tube you are trying to replace and get one described as "Universal Ballast". You then just unplug the old tube and starter and plug in the new tube and its starter and the job's done. I replaced a 58W 1500mm T8 tube with a 24 watt, ultra high efficiency, daylight tube. Apart from the reduction of electricity use, it has the added advantages of coming on immediately and being much brighter.

2.2.3 Efficient Use

The amount of energy actually used by some appliances varies with how they are used.

Most of the energy used by washing machines is used to heat the water. Thus, if the water coming into the house is at, say, 10C and the machine is washing at 40C, the machine has to raise the temperature of the water by 30C. If however it's washing at 20C, it only has to heat it by 10C and thus uses about one third of the electricity. As far as I can tell, washing at higher temperatures than 20C has no advantage. Plain, old fashioned Persil soap powder washing at 20C will remove all normal stains and even black, sticky, railway grease from overalls. It seems that, if washing at 20C won't shift a stain, neither will washing at higher temperatures. From a hygiene point of view, as I understand it, washing at any temperature normal clothes will withstand will not kill bacteria while washing at any temperature will destroy viruses anyway. Thus, whatever temperature you wash at, bacteria will survive and viruses won't. If sterilisation is a requirement, you can get tumble driers that have a setting in which they the heat clothes for long enough and hot

enough to kill bacteria. This is more energy efficient as you only have to heat the clothes, not the water and the clothes.

Even ‘A’ rated tumble driers are big users of electricity. The lowest CO2 way of drying clothes is the old fashioned washing line. As it has no emissions, it just cannot be beaten. I avoid using the tumble drier whenever possible and just give the clothes a quick whirl in the drier to soften them up afterwards. I have found the met office’s rainfall radar an almost infallible way of telling whether it’s going to rain in the next few hours.

Another appliance whose emissions depend on use is the humble kettle. Its electricity use will, to a first approximation, be directly proportional to the amount of water in it. Thus having a jug kettle with a flat bottom and only putting a bit more water in it than you need will minimise electricity use. It’s quicker too.

Finally one should be a bit wary of leaving things on standby. They do use power on standby and sometimes it’s not a trivial amount.

2.3 Petrol and Diesel

2.3.1 Introduction

On the assumption that petrol and diesel are sufficiently expensive and driving is sufficiently tedious that we don’t drive unnecessarily and that we don’t floor the accelerator at every opportunity to show off, the main opportunity for reducing our emissions is to change our car for something more efficient. There are probably some assumptions here about whether driving to recreational activities is ‘necessary’ but I won’t debate that here.

In principle, the decision making process when choosing a new car is simple. Firstly we make a list of all the models that have the necessary range and people carrying, load carrying and towing capabilities. We then eliminate any models that have unacceptable features… no spare wheel, wife can’t reach the pedals, won’t fit in the garage etc etc. Of the models remaining in the list, we then choose the model with the lowest CO2 emissions. Job done!

Of course, life isn’t actually that simple. The first complication is that we may also be concerned about air pollution, that is about a car’s toxic emissions.

2.3.2 Toxic Emissions

Toxic emissions is a subject about which newspapers have had a lot to say over the last few years. The gist of the archetypal air pollution newspaper story is…

1. Thousands of people are being killed every year air pollution
2. Levels of Oxides of Nitrogen frequently exceed the limits
3. In real driving, diesel cars exceed their limits by a large margin

Newspapers wrote these articles in a way which implied that the deaths were the result of the Oxides of Nitrogen frequently exceeding the limits. As far as I can tell, they never had any evidence that this was true. More recently, the EU did a big fancy study of the subject and concluded that air pollution shortens the life of the average EU citizen by 9 months and the average Londoner by 2 years. You will note here that outright killing has been commuted to shortening of life. More importantly, it showed that 80% of the shortening of life is caused by particles. All other pollutants… sulphur dioxide, ammonia, carbon monoxide, volatile organic compounds and oxides of nitrogen are responsible for the remaining 20%. There is a view that the contribution of oxides of nitrogen is small, possibly zero. It must also be said that all current model diesel cars and some older models (including mine) do not exceed the limits for oxides of nitrogen in normal circumstances.

This puts the subject of cars and air pollution in a whole new light. Most of the particles emitted by cars come from tyre wear and road wear not from the exhaust pipe. The particles from tyres cover a large range of sizes including extremely small ones. This suggests that diesel cars may be the least damaging to health as they are lighter than electric cars (therefore less tyre wear) and have filters in their exhaust systems which petrol cars generally don't. If you are interested in this, you should look up 'Emission Analytics' who have studied the subject extensively. The conclusion I draw is that we should choose the car with the lowest CO2 emissions that will do the job regardless of its fuel.

2.3.3 Emission Tests and Numbers

The next slight complication is that there are two different official tests for cars. There is the old NEDC test and the new, improved WLTP test. If the cars you are considering are fairly new and have figures for the WLTP test, you should use these, otherwise you will have to use the

NEDC figures. What you should not do is compare WLTP figures with NEDC figures.

The old test was divided into two parts, the low speed (urban cycle) and the high speed (extra urban cycle). The new test is divided into 4 parts (slow, medium, fast and very fast). If your driving is largely pottering about, it would be better to look at the figures for lower speeds. At the opposite extreme, if it's all motorway, you would be better looking at the figures for higher speeds. I'm told that the Prius (probably the previous model) is very good around town but gets distinctly thirsty on the motorway… the faster you go, the worse it gets.

The next hazard is that the CO2 figures published for electric cars and plug in hybrids involve a certain amount of creative accountancy. In neither case, do they include the CO2 emissions caused by the additional electricity demand they create. As with the use of heat pumps, the extra CO2 emissions are tricky to calculate but they are in the range 0.28 and 0.465 kg per kilowatt hour depending on whether the building of low CO2 generating capacity keeps pace with the additional demands or not. The CO2 emissions of an electric car can be calculated by multiplying the kwh per km figure in the manufacturer's brochure by the kg per kwh figure of the electricity generation system. Thus for a Nissan Leaf…

Optimistic 0.15 * 0.28 * 1000 = 42.00 gm/km
Pessimistic 0.15 * 0.465 * 1000 = 69.75 gm/km

You will notice that the latter figure is little different than a Toyota Prius (a car powered by petrol).

The figures for plug in hybrids assume a certain mix of long and short journeys, mostly short. This is OK if that matches your use of the car. On long journeys however you are likely to find that they drink fuel as they are heavy and are powered by petrol. I saw a figure of 40mpg quoted in one of the papers. This compares very unfavourably with my car's long distance journey performance of 65-75 mpg.

2.3.4 Making a Choice

2.3.4.1 Pure Electric Cars

If one is optimistic about the continuing development of the electricity generating system, a pure electric car will offer the lowest CO2 emissions. The main difficulty is likely to be whether it will do the job.

This depends very much on what you are going to use it for. If it is going to be a second car that will never need to go far from home, then, very likely, it will do the job. The main concerns are likely to be the initial cost and, if the annual mileage is going to be low (because it never goes far from home), the limited reduction in CO2 emissions.

If however, it is going to be the main car and needs to go from Verwood to Penrhyndeudraeth (280 miles), get there in a reasonable time (ie before the driver gets tired), sit in a road outside a B&B with no charging facilities for a week and, on other occasions, tow a boat or caravan then it's going to be a non starter. There may, of course, be improvements in battery technology that will remove these obstacles but they do not appear to be just round the corner.

2.3.4.2 Plug in Hybrid Cars

The above problems are, of course, precisely why car manufacturers are offering plug in hybrids. However one would need to look very carefully at their performance when running on petrol/diesel. Their CO2 emissions can be calculated by working out how much fuel and how much electricity they will use in a year and multiplying by the appropriate factors. Again the main concerns are likely to be the initial cost and, if the annual mileage running on electricity is going to be low, the limited reduction in CO2 emissions.

2.3.4.3 Non Plug in Hybrid and Other Cars

If pure electric cars and plug in plug in hybrids fail to meet your requirements, fail to offer sufficient reductions in CO2 emissions or the price tag makes you wince, you are left with buying a car powered by petrol or diesel. These might or might not have their efficiency enhanced by a fancy transmission involving electric motors and batteries. Either way you just look at the numbers and make a choice. On paper, the current Prius is the lowest emitter I am aware of.

Having gone through the above process, I didn't buy an electric car because of range, I didn't buy a plug in hybrid because of the high prices and inadequate fuel efficiency information and I didn't buy a Prius because of its low towing capability, doubts over its performance in real driving and its high particle emissions. I thus wound up with a VW Passat Blue Motion (the extreme efficiency 96 gm/km version). Whether I'd make the same choice today I don't know, I haven't looked at current model cars.

2.4 Flying

When flying we do not get to choose the type of plane, how full it is nor do we get to design it. Thus the only control we can exercise over our flying emissions is how many flights we take and how long they are.

It is merely stating the obvious to say that one week in Prague has one third of the emissions of three weekends there or that two weeks in Spain has something like half the emissions of two weeks in Tenerife (a two hour flight against a four hour flight). Similarly it is obvious that a business Zoom call to China has a lot less emissions than flying there… cheaper and quicker too.

There is no quick technological fix in sight for flying emissions. Plane design is improving all the time and each new design is better than its predecessor but the improvements are small. Powering planes by hydrogen is talked about but hydrogen is difficult to store and requires a different design of plane. More fundamentally, it requires that the hydrogen is manufactured using energy obtained without burning fossil fuels and thus depends on a vast expansion of nuclear or wind or solar electricity generation. A second alternative is to run existing planes on synthetic kerosine. This requires either large areas of land to be devoted to the feedstock crops or again a vast expansion of low CO2 electricity generation. Both these options are decades away and will require the traveler to pay the considerable costs associated with them.

For some destinations and if you are not in a hurry, taking the train may be an alternative. This is particularly true for France where there is an extensive high speed network and the CO2 emissions of trains in France are particularly low because of the widespread electrification of railways and the large scale nuclear electricity generation there.

Thus, in the case of flying, the better organisation of our lives is the only available method of reducing our emissions for the foreseeable future.

2.5 Conclusion

We should now be in a position to begin to understand our options for reducing our emissions caused by our using gas, electricity, petrol, diesel and by our flying. This is the next step on the road to doing something about it.

I am very happy to give help to anyone who needs it and equally happy to learn from others. I hope this proves to be of some interest.

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