TEN YEARS OF SOLAR PANELS AND CARBON FOOTPRINTING

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A. SOLAR PANELS

The end of April 2020 saw us complete 10 years with our solar PV array on the roof. I have kept daily records of the electricity generated, so it's interesting to review the performance over that period.

The array consists of seven Powerglaz SMT6 panels manufactured by Romag, mounted on our roof at 40° and facing due south, with a capacity of 1.61 kW peak power, and a (rough) estimate of 1342 kWh generation per year. The inverter is a Sunny Boy SB1700 made by SMA Solar Technology AG. The installation has survived snow, ice and high winds and has been entirely trouble free. Cleaning is provided free of charge by rain.

The amount of electricity generated depends, of course, on the amount of sunlight, and there are four variables:

1. The amount of cloud;
2. The seasonal variation in the angle of the sun and the length of daylight;
3. The temperature – the panels operate more efficiently at low temperatures;
4. The age of the panels – output is warranted to be not less than 80% after 25 years.

The pattern of generation over the decade shows the prediction to have been remarkably accurate: the annual figures (in kWh) are:

1425.6, 1385.1, 1277.3, 1407.1, 1399.2, 1347.6, 1239.5, 1264.6, 1443.6, 1393.0 = average 1358.3

The seasonal pattern varies similarly from year to year, and shows:

- That the Spring (average 283 kWh for March-April) is consistently sunnier than the corresponding Autumn period (average 213 kWh for September-October);
- That the four Winter months (November-February) have generated an average of 201 kWh, compared with 661 kWh over the four summer months (May-August);
- That (perhaps surprisingly) the panels generate almost a third as much electricity in the winter as in the summer.

The figures show no uniform trend over the ten years. No conclusions can be drawn from them about global warming, since a rise in global temperatures does not in itself increase the amount of sunlight, and in our Atlantic seaboard climate can cause more cloud. (Having said that, I note that the combined generation figures for April and May 2020 are a whopping 403 kWh compared with the next highest of 355 kWh in 2017, 351 kWh in 2019 and 345 kWh in 2015.)

B. CARBON FOOTPRINTING

Calculating our carbon footprint each year tells us how many tonnes of CO2e ("carbon dioxide equivalent" = CO2 + other greenhouse gases) our household is putting into the atmosphere, and helps us to identify changes we can make. It is calculated on the basis of our consumption of energy in two main categories: in our home, for heating, lighting and other purposes, and in travel. This entails keeping a record of the number of units of electricity, gas, oil etc we use, and also our travel mileage by private car and public transport.

The relevant figures are entered into an on-line carbon footprint calculator which converts them into tonnes of CO2e. A complication over the decade has been that we have had to use three different on-line calculators:

- *ActOn CO2, which was originally run by the government and then outsourced to another agency until 2014, after which it ceased to exist;
- **Forest Credits from 2015 until 2017;
- ***Carbonfootprint.com from 2018.

Each calculator has a slightly different method of converting the data into tonnes of CO2e: for example, Forest Credits did not take into account the decarbonization of the national electricity supply, whereas Carbonfootprint.com allows us to enter the CO2e emissions factor for each individual electricity supplier. So in looking at our carbon footprint over the decade, we are not always comparing like with like. But we believe the figures are becoming more accurate, and they show our direction of travel.

We live in Little Stretton where there is no Natural Gas available, and our house is heated by oil. Our carbon footprints (in tonnes) for a two-person household are as follows:

	Home	Travel	Total	(Flights)	(net of flights)
2010*	4.74	6.52	11.26	(US 2.17)	9.09
2011*	4.84	3.03	7.87	None	7.87
2012*	3.84	2.73	6.57	None	6.57
2013*	3.99	2.42	6.41	None	6.41
2014*	4.80	2.77	7.57	None	7.57
2015**	3.90	4.05	7.95	(Europe+IOM 0.8)	7.15
2016**	3.71	3.03	6.74	None	6.74
2017**	3.31	4.69	8.00	(2xEurope 1.26)	6.74
2018***	3.91	6.68	10.59	(Cruise 3.6)	6.99

2019***	3.52	2.49	6.01	(2xEurope 0.63)	5.38
2020***	3.70	6.21	9.91	(NZ 5.61)	4.30

We buy our electricity from Ecotricity, which sources its supplies exclusively from 100% renewable generators including their own wind farms. By using the carbonfootprint.com calculator we can base our footprint on this renewable source rather than on the grid average. Allowing for times when the sun isn't shining and the wind isn't blowing, we calculate this at 99gm/kWh rather than zero *(see below □)*, but this is still well below the national average of 241 gm/kWh. Changing to a 100% renewable supplier is one of the simplest and most effective ways of reducing our carbon footprint.

The figures show that the most variable element in our footprint is travel, especially flying. I have listed separately the footprints for the flights (and one cruise) we have made, to show:

- What a large difference these make, especially long haul flights. They included flights to the US in 2010 for a family wedding, and a once-in-a-lifetime visit to New Zealand in 2019.
- The years when there were no flights included several journeys to Germany and Austria by train. A return flight for two people from the UK to Munich produces 0.6 tonnes of CO2e, compared with 0.03 tonnes when making the same journey by train.
- Separating out these journeys highlights the importance of avoiding flying, and also shows the downward trend of the other elements of our carbon footprint.

The biggest single reduction came about through replacing our diesel car with an electric car in 2018. Using renewable electricity, this immediately reduced the carbon footprint of our car from 2.3 tonnes to 0.9 tonnes.

The next biggest change we could make – but have not yet done so – would be to change our oil-fired heating system to an air-source heat pump. Since this would also be powered by renewable electricity it could save up to a further 3 tonnes of CO2.

Our own household carbon footprint compares with the UK average of 6.5 tonnes of CO2e per person (ie 13 tonnes for a two person household). The world wide target to combat climate change is 2 tonnes per person.

We all need to reduce our carbon footprints in order to address climate change. Stretton Climate Care would be delighted to help anyone in our local communities work out your own household footprint, and demonstrate the methodology so that you can regularly update it yourself. Please contact us using our contact form on the website or our listed telephone number.

(□ This assumes that three quarters of our electricity comes from 100% renewable sources whose carbon emissions factor (CEF) is zero, and one quarter from gas turbines whose CEF is 394 g/kWh.)