

Our Household Energy Transition

Becoming a Fossil Fuel Free Family

2022 Energy Update

Dave Southgate
Feb 2023

Foreword

I retired from work and moved into our current house in late 2012. At that time I began the process of transitioning the direct energy use of our family from 100% fossil fuels to 100% renewables. I have written annual, and other, reports over the past decade about our energy transition and posted these on my website. We are now essentially fossil fuel free when considering direct energy use in our house. While our main family car has been an EV for nine years, we still own a small petrol car that now dominates our family direct carbon footprint.

In the early years of our energy transition, we made significant new investments in our energy systems each year, but inevitably, as we have come closer to reaching our goals, the rate of change has slowed dramatically. Hence in recent years our energy use patterns have been looking very similar from year to year. Given this, I am now moving on to a different reporting format. In simple terms my aim is, from now on, to focus on showing long-term trends rather than actions in individual years. I plan to move from prose to a more dot-point style of presenting information.

I will continue to gather the same monitoring data that I have been gathering throughout the project. However, I intend to solely track our high-level energy use/carbon footprint, and no longer show detailed breakdowns of individual energy consuming devices. I will primarily report, rather than discuss, any key events.

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February 2023

Author: Dave Southgate is a retired environmental bureaucrat who spent more than 30 years working in pollution control areas in Australian State and Federal Governments. In the last decade of his career he primarily focussed on developing climate change control strategies. His family energy transition is a personal project attempting to put in place, and document, steps households can take to attain a net zero carbon footprint. He has no commercial interests in any of the products he refers to in his reports.

Background

This annual energy use update is best read in the context of the reports I have produced on our household energy transition over the past decade. These reports give details of the methods I have used to arrive at the data shown in this energy update.

You can find consolidated information on our household energy transition project at my website: <https://netzeroemissions.net/>

In addition to this energy update, I propose to produce an ongoing annual carbon footprint update for our household total carbon footprint (direct + indirect). I intend that this will build on the [household carbon footprint reports](#) I have produced in recent years. These will report the steps we take each year to be a carbon neutral family.

I now feel that I have largely achieved what I set out to do 10 years ago and hence I don't believe continued reporting is necessarily achieving a great deal. Having said that, I fully recognize that working on one's carbon footprint will never be complete, and as new ideas/technologies emerge there will always be steps that we can take to gain further ground. I certainly intend to keep following energy/carbon issues very closely and act when I can.

In future updates I intend to report any significant changes in our energy use patterns in the 'Key Events' section.

2022 Key Events

- Jan** Our Enphase microinverter system developed problems. Seven of the 17 inverters in this system began generating intermittently. It took some weeks for this to be sorted out.
- Jan** La Niña became very apparent with noticeably more cloud cover than normal. This persisted throughout much of the year. These first two events resulted in a greater than 10% drop in our solar PV output for the year compared to 2021.
- Jan** We went on our first extended trip in our Tesla Model 3. We were away for just under two weeks – we travelled up the coast as far as Coffs Harbour and came back via the inland route (Armidale, Tamworth, Mudgee, etc). Key stats: 2,158 km; 15.1 kWh/100km; used approx. 320 kWh.
- Mar** As part of some low-key research on how to cope with a knee injury, I discovered a beautiful new human powered way to get around – [kickbikes](#) (or [footbikes](#)). I now have three different types of these wonderful machines.
- Jun** Increasing energy costs across the globe stimulated interest in low cost/energy ways for people to stay warm in their homes. The Guardian came across some of my work and published this article: ['Why are we heating the air?' Australians turn to warming gadgets as cold and energy costs bite | Homes | The Guardian](#).
- Jul** The ABC learnt of the Guardian article, and I was interviewed on [the ABC Sydney radio Breakfast Show by James Valentine](#) (start around 25 min mark).

Trend Reporting

The next six Figures are extensions of Figures that I have included in the Transition Book and the subsequent Annual Reports over the life of the project.

Energy Consumption

Year	Grid Electricity		Gas		Petrol		Total	
	kWh	CO ₂ (kg)	kWh	CO ₂ (kg)	kWh	CO ₂ (kg)	kWh	CO ₂ (kg)
2013	1,790	1,539	8,466	1,559	16,206	3,888	26,462	6,986
2014	4,128	3,550	8,426	1,552	4,964	1,191	17,518	6,293
2015	4,945	4,249	1,460	269	4,964	1,191	11,369	5,709
2016	3,735	3,137	-	-	4,964	1,191	8,699	4,328
2017	2,757	2,604	-	-	4,964	1,191	7,721	3,795
2018	653	535	-	-	9,308	2,258	9,961	2,793
2019	1,113	902	-	-	7,990	1,938	9,103	2,840
2020	474	384	-	-	5,168	1,254	5,642	1,728
2021	531	419	-	-	8,223	1,995	8,754	2,414
2022	584	426	-	-	7,588	1,841	8,172	2,267
% Change 2022/2021	9%	2%	-	-	-10%	-8%	-7%	-6%

[The Figure only shows our imported energy data – it does not include the consumption of our own solar PV electricity.]

Energy End Use

Year	Hot Water (kWh)	Thermal Comfort (kWh)	Cars (kWh)	Other (kWh)	Total (kWh)
2013	2,920	6,194	16,206	1,142	26,462
2014	2,555	6,463	7,581	1,338	17,937
2015	2,213	1,995	7,396	2,109	13,713
2016	1,733	983	7,482	2,516	12,714
2017	1,782	569	7,655	2,718	12,724
2018	1,692	342	11,914	2,223	16,271
2019	2,040	367	10,695	2,249	15,351
2020	2,417	676	7,403	2,871	13,367
2021	2,451	755	10,501	2,424	16,131
2022	2,242	763	10,584	1,753	15,342
% Change 2022/2021	-9%	1%	1%	-	-5%

Energy Generation (solar PV)

Year	Solar PV Total Production (kWh)	Imported Energy Consumed		Exported Electricity		Net CO ₂ Footprint (kg)
		kWh	CO ₂ (kg)	kWh	Displaced CO ₂ (kg)	
2013	2,772	26,462	6,986	2,772	2,384	4,602
2014	4,906	17,518	6,293	4,476	3,849	2,444
2015	10,980	11,369	5,709	8,863	7,622	-1,913
2016	12,251	8,699	4,328	8,265	6,942	-2,614
2017	14,119	7,402	3,795	6,413	5,323	-1,528
2018	15,225	9,961	2,793	8,613	7,063	-4,270
2019	15,421	9,103	2,840	9,169	7,427	-4,587
2020	19,320	5,642	1,728	11,595	9,392	-7,664
2021	20,323	8,754	2,414	12,572	9,932	-7,518
2022	17,927	8,172	2,267	10,356	7,250	-4,983
% Change 2022/2021	-12%	-7%	-6%	-18%	-27%	-26%

Costs

Year	Electricity (\$)	Gas (\$)	Petrol (\$)	Total Fuel Bill (\$)	Credit from Solar (\$)	Net Fuel Bill (\$)
2013	475	991	2,558	4,024	1,241	2,783
2014	766	1,112	780	2,658	902	1,756
2015	1,085	488	676	2,249	1,495	754
2016	886	-	676	1,562	1,559	3
2017	818	-	676	1,494	1,742	-248
2018	499	-	1,365	1,864	1,811	53
2019	617	-	1,153	1,770	1,859	-89
2020	490	-	702	1,192	1,962	-770
2021	495	-	1,356	1,851	1,931	-80
2022	527	-	1,463	1,990	1,684	306
% Change 2022/2021	6%	-	8%	8%	-13%	

Carbon Footprint of our Direct Energy Use

Year	Hot Water (kg CO ₂)	Thermal Comfort (kg CO ₂)	Cars (kg CO ₂)	Other (kg CO ₂)	Total (kg CO ₂)
2013	538	1,326	3,888	982	6,734
2014	470	1,376	3,442	1,151	6,439
2015	435	1,594	3,283	397	5,709
2016	80	826	3,283	139	4,328
2017	48	472	1,784	1,491	3,795
2018	26	280	2,445	42	2,793
2019	21	297	2,059	463	2,840
2020	27	223	1,308	170	1,728
2021	10	596	2,072	342	2,414
2022	-	560	2,463	250	3,273
% Change 2022/2021	-	-6%	-19%	?	40%

Transition Snapshot

Year	Key Actions	Key Outcomes
2013	This was our baseline year – we moved into our house in late 2012. In 2013 I simply monitored energy use and did not change any of the energy settings. We were a 100% fossil fuel based family - we used gas for heating, hot water and cooking. We had two petrol engined cars. We had no solar PV self-consumption.	We obtained some good baseline energy consumption data.
2014	We replaced one of our cars with an EV (Nissan Leaf). We installed a 2kW solar PV system. I produced a book on our EV experience .	Reduced our petrol energy use by around 70% and our car energy use by around 50%.
2015	This was the year of the major moves. We progressively weaned ourselves off gas over the year. We installed a 4kW solar PV system; an energy diversion device (Immersun) for our hot water; a storage heater for space heating in our main living area (not a success); and FIR panels in a number of rooms (wonderful!).	Eliminated the use of gas. Demonstrated the solar self-consumption abilities of energy diversion devices. Began to understand the energy and comfort benefits of personal (as opposed to space) heating.
2016	I released my ‘Energy Transition’ book . I purchased a CO ₂ monitor which led to me eschew rampant draughtproofing . Indoor air quality was a key factor in my beginning down the path to becoming an advocate for the ‘heat yourself: not your house’ philosophy. I cross-linked our EV charging with our energy diversion device . We changed over all lights in the house to LEDs. I evaluated the performance of our FIR panels and produced a report .	Linking our EV with our energy diversion device resulted in about 60% of our EV energy use coming from our solar PV system. Realisation that there is no need (in fact it is problematic) to seal a house. Advanced my understanding of the benefits of radiant heating.
2017	We installed a further 2kW of solar PV and a Tesla Powerwall 2 battery (brilliant!). We didn’t heat our house over winter – we heated ourselves. This proved so successful I released a book on personal (as opposed to space) heating . This has been by far the most popular energy report I have produced.	Installing the house battery took the project forward by a great leap – in 2016 we imported about 25% of our electricity; in 2018 (the first full year with the battery) we imported about 10% of our electricity. I discovered the world of low energy, personal, heating.

2018 We installed an enhanced house energy monitoring system (Solar Analytics). I discovered an [item of heated clothing which really works indoors](#). I began exploring personal cooling and purchased/tested [a low powered USB evaporative cooler](#).

Demonstrated that ultra-low energy heating really works – you can keep very warm using clothing with in-built USB thermal patches (pulling 10W or less). Installing the Solar Analytics system significantly improved my energy monitoring/reporting capability.

2019 We converted our house electricity system over from single phase to three-phase. We bought a second-generation EV – the new Nissan Leaf. I bought, and tested, [a personal refrigerated air conditioner](#). I purchased an [adjustable heated vest](#) which allows optimised personal heating.

Converting to three-phase set us up for installing additional solar PV. The new Leaf opened up the possibility of relacing many of our petrol based regional trips with EV trips.

2020 We installed an additional 6kW (export constrained) solar PV system. I released our first household Carbon Footprint Report.

The installation of the additional solar PV + the purchase of some offsets enabled us to become a carbon neutral household.

2021 We bought a Tesla Model 3. At the same time, we installed a Zappi EV charger which replaced our earlier (ersatz) direct solar PV energy charger. We took our ‘heating yourself’ concept further by discovering the ‘Oodie’ and USB hand warmers.

The Model 3 proved game changing. We had acquired an EV that far surpassed any petrol car we had ever owned.