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Household carbon footprint reduction: a personal case study

This summary should be used in conjunction with the presentation slides.

This case study follows on from Jim's presentation as an individual example of behavioural change. It illustrates the experience of my wife and I as we undertook to reduce our environmental footprint through reduced electricity, gas, car and water use over twelve months.

There are just the two of us now in an inner city, two story townhouse. I retired 18 months ago after a career at Melbourne University that moved across atmospheric physics, electronics, programming, academic teaching, professional development and research. This project is a continuation of my academic interest in innovation and the adoption of technologies within communities. I am also a compulsive data collector...

Initial motivation for reducing our footprint came from a shared belief in doing the right thing, but put off for years because of a busy lifestyle and other priorities. At the time of retirement, necessary thought about investments triggered a decision to finally install photovoltaic solar panels.

Why is it that a new car fitted with a sunroof costing thousands or holiday on Hamilton Island passes without comment, but mention you're going to buy solar panels and you're cross-examined about the return on investment? To me a far more worthwhile investment...

This case study is of course just one personal experience and may not apply to other situations -you need to judge this yourselves. The challenge for ATA is to be aware of such individual perspectives in order to widen its community impact.

In addition to the solar panels, over the last 18 months we have put in louvres, blinds and shades, a water tank, bought a motor scooter and revised our use of appliances and transport. Each step involved a series of often tricky decisions. Consider just one:

- Q. What's the best way of making a cup of tea with minimum carbon footprint?*
- A. Common electric jug
 - B. Gas kettle
 - C. Microwave, or a
 - D. Tefal 'Quick Cup'

[Most thought the gas kettle, some the microwave]. After some investigation I concluded that our gas kettle is approximately ten times less energy efficient than the electric jug, therefore about three times worse in carbon emission (gas has a lower carbon output). The electric jug however, only heats a minimum of *two* cups. The 'Quick Cup' promises "hot water in 3 seconds" and up to 65% the energy, but feedback in Renew and Choice indicates the water may not be hot enough to actually make a good cuppa. While the microwave is less efficient than the jug, it heats exactly one cup and appears to be technically the best (just). In the end, the jug is more practical and what we use.

This exercise illustrates the thinking you have to apply time and again - to investigate alternatives, filter green wash, measure, question habits, adjust expectations and arrive at some pragmatic compromise. Not easy at all.

Data gathering

Once motivated to take action, understanding our appliance energy use became essential. Starting very much in the dark, I began gathering data:

1. An *initial household energy audit* – extended over several months measuring about 60 different appliances plus different types of use.
2. *Daily recording of household data* – once the panels were installed in January 2008 and I started logging their output, it seemed logical to also track our electricity use, water, gas, car, bike, refrigerator and house temperatures each day. A Powermate energy meter was used.

Reduction in energy use

Over 12 months, we can track a drop in average daily electricity use of 4.5kWh - from a two-year average of 7.5 kWh to under 3 kWh. Most pronounced savings occurred immediately after the panel installation when we went around switching off everything we could to prevent Origin eating up our hard earned solar exports. This saved 2kWh in standby power for no cost and little effort - the worst culprits were the central heating system, HiFi components and printer. We made additional changes throughout the year and consolidated better habits. A new fridge had a significant impact mid year.

Photovoltaic Solar Panels

The 1.5kW solar panels were installed in January 2008 after a number of quotes over several years. Even then, we did not have a handle on all the factors and advice was somewhat variable. It was important for me to see how the panels were operating so we added the optional wireless display. This cost ~\$600, but added massively to my understanding and daily appreciation of the system. Output has averaged 5kWh over the year, varying substantially over the months. While not our original intention, we now are a net exporter to Origin Energy and are in credit. Although Origin are probably the best company around, we have had issues with every bill since installation. For example, even though we were exporting to them, we were still being charged for 20% Greenpower.

The panels make up about half of the average daily savings we have made - but cost \$10,000 (the new feed-in tariff will help here). The new fridge contributed 15% and cost ~\$700. Using the dishwasher less and the clothes washer on a different cycle contributed 8%. A small toaster oven to supplement the electric stove and other bits and pieces cost around \$100 and contributed 6%. *The real 'no brainer' however, was simply reducing standby power of appliances - saving 20% for no cost and generally little effort. It needs to be emphasized that installation of the solar panels was absolutely critical in raising our awareness to bring about this action.* It all adds up.

We were initially disappointed with the panel output – the peak power rarely exceeded 1.2kW compared with the rated 1.5kW and the daily average output seemed less than the 5.8kWh quoted. It took time to build trust in the system and understand the factors at play. For example, variation in the sun's path was a revelation with trees unexpectedly blocking morning sun in summer and winter. The monthly maximum output (assuming at least one sunny day per month) indicates that our maximum output is in Autumn/Spring - influenced not only by the trees, but also lower output in higher temperatures and a panel elevation of 32° optimized for mid season.

Net vs. Gross feed-in tariff

Getting to understand the Net vs. Gross feed-in tariff issue was difficult. After the import/export meter was installed in April, the daily figures started showing how this should work for us. Our *net export* is averaging about 85% of the gross panel output due to our low energy use. When the 60 cent tariff is introduced this should return ~ \$1000 annually from the \$10,000 (from net export and reduced import figures). Not bad compared with \$330 from the current Origin 20 cent feed-in tariff. The proposed net feed-in system is confusing. It doesn't measure what we're trying to achieve (lower carbon output) and forces silly behaviours. For example, you try to do washing at night otherwise it eats into that net export - you would be effectively charged 3X normal power use. The net scheme however, does provide a *very strong incentive to reduce energy use*. If you don't, the tariff could easily end up practically worthless. A gross system gives no such incentive.

Fridge

The fridge is critical to maximizing net export as it runs during the day when the panels are generating. I'd been looking for the 'ultimate' energy efficient fridge for ages, but finally just

bought a standard 310L Westinghouse - smaller than the old one. Even though our family has down-sized, changing expectations of what the fridge had to provide was not an obvious or easy choice. Human instinct is to always want more, assisted by the manufacturers who have up-sized their models since we last looked 15 years ago. It was off-putting that the smaller model had fewer stars (4.5 instead of 4) disguising the fact that it uses less power overall. The new fridge saves about 1.5 kWh a day, with energy use strongly dependent on temperature..

Transport

We intend to get rid of the car eventually, but in the mean time have reduced its use - about 5000km annually shared around the family. We are now regularly using local and interstate public transport, push bike and most recently, a motor scooter. The inner city location and less work-orientated lifestyle are major factors when adjusting to the idiosyncrasies of the PT system.

Another trigger for change was the *car fuel efficiency display* in our Honda Jazz. It immediately made me realize how driving conditions and style affected fuel economy. We are averaging about 6.7L/100km (equal to the government figure), but individual journeys under 10km vary from 7-13L/100k. The air conditioner pushes this to the maximum. For the few long trips the mileage dropped to about 5.5. It's important to acknowledge that these few long trips actually contribute most to petrol use (and carbon output).

Heating and cooling

Louvres installed on the N and S side of the house made an enormous difference to managing daytime temperatures. Using these passive methods - adjusting ventilation and managing blinds and shade - is somewhat akin to sailing a yacht; an air-conditioned house is the powerboat that is simply switched on. Different people will no doubt prefer one or other approach. Dealing with the *adversity is another trigger for change*. The recent heat waves forced new understanding of how the house worked – and action! I realized the importance of sealing all those cracks and insulating windows. We replaced the awful gas central heating with an excellent Archer 5.5 star gas space heater that dropped our winter gas use to nearly one third. Even so, it was only when comparing gas and electricity figures that I realized how significant gas was to our total carbon emissions (both ~1 tonne annually). I'll apply the lessons learned in summer to focus on window insulation for winter

Water

Our small vegetable garden is watered from a 1000L tank, but removal of the central heater will make room for a second larger one to feed the toilet cisterns, at least over winter. We also plan to replace the hot water storage tank with an instantaneous gas system. We use too little hot water to justify a solar boosting and also need the space. Water use is a lot easier to comprehend than electricity - you know what a bucket of water is and what effect it has on a garden – but it's hard to break old habits. I've become used to taking a 'Navy' shower (rinse down, water off, soap yourself, then final rinse). This can *easily* save 20-30 L over a regulation 4 min shower – over 7,000L a year! Cheaper and simpler than a tank, uses less gas and may even be better for your skin. Not for everyone though.

Communications

In the living room, an Apple iMac has replaced the TV, VTR and DVD player and has low energy consumption (and only one remote!). A lot of my computer use is now done on an iPhone, which uses practically no power. It is also proving invaluable for navigating the Public Transport system and picking up latest weather reports for 'sailing' the house.

Lighting

I've been trialing halogen downlight alternatives but found no ideal solution. In the meantime we disabled about half the units and mainly use higher efficiency floor and desk lamps. It's depressing that the building regulations have not caught on. My daughter recently bought an apartment in which the main room has 12 halogens on a single switch– 600W. Used 5 hours each night this would practically wipe out the output of a 1kW solar system.

Observations and reflection

Monitoring and changing your own energy use is one thing, but care and subtlety is needed with significant others, e.g. length of showers is a personal thing. My wife and I are both committed to lowering our footprint, but have different ways of understanding and going about things.

Key triggers that drive change are important to consider. For us these included down-sizing (e.g. smaller house, fridge), children leaving home, times of investment/superannuation decisions (e.g. preparing for retirement), installation of the solar panels, availability of tariffs & subsidies, water restrictions and the heat wave. ATA involvement, house visits, talking with others and even preparation of this presentation have helped also.

I have found that information about what to do *is* generally available but is overwhelming and hard to absorb until you actually become involved. Personally I am really only comfortable when I can build my own models of how things work and tend to do this by collecting my own evidence.

The ATA needs to be aware of its audience. This could be seen at four levels: the *innovators* (might write for Renew magazine); *early adopters* (read Renew); *potential adopters* (might glance at it in the doctors waiting room) and the *wider community* who have little interest. Innovators may tend to focus in great detail on particular approaches, such as solar panels or double glazing, but find more mundane solutions less interesting. To achieve most effective carbon emission reduction, a top down, bottom up approach is appropriate – keeping the primary aim in mind, making a holistic assessment, applying resources to the most effective change and then back again.

There may be a role for ATA providing some sort of auditing, mentoring or case management service to help households deal with the bigger picture. The government clearly should be mandating standards and setting incentives. Programs like the Carbon Cops have a good educative role (their Web site is actually very good). Lastly at a local level, community discussion among householders is the best way for people to see what is being done by their peers and build trust in the information provided.

Questions

Is a fridge is more efficient when filled? All I can say is - we tend to do our shopping and fill the fridge on Saturday. Power use rises then by about 10% and then progressively drops each day for the rest of the week. It does appear then that the more you have in it, the more power is used.

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Links:

Archer gas log space heater: <http://www.auroraclimatesystems.com.au/efficiency.html>

Carbon Cops <http://www.abc.net.au/tv/carboncops/>