RENEWABLE ENERGY – Barry Smith

Renewable energy has fascinated me for many years and in early May 2006 we installed Solar Water Heating. The average Electricity consumption for a household totally dependent on Electricity for heating hot water is about 4,500kW Hrs a year (4,500 units). One of the good things about the house we moved into at Otatara was that it had a wetback on the fireplace, this provided good water heating during the Winter and with the summer being augmented with Solar we found that Water heating energy from Grid electricity, wet back and Solar fairly evenly split the energy to about 1500 kW Hrs each. The all up cost for this project, including compliance and upgrading our switchboard cost about $7,500. Keeping a close eye of savings I believe that about 1st January 2024 the Solar Water system paid for itself with a calculated rate of return of about 6.9% Tax Free.

Another dream we had was to install PV (Photovoltaic) Cells and produce electricity. The process for them to become economic has taken nearly 65 years. Initial PV cells produced in the late 1950's and early 1960's cost about 20USD / Watt output (around $500 ~ $600 / watt inflation adjusted). By the time the late 1960's / early 1970's arrived the cost had managed to drop to 10USD / Watt (about $160 ~ $170 a watt, inflation adjusted) and they remained at that price for many years.

There was a massive change about 2008 when the Chinese started building factories for manufacturing PV cells without much thought of the economic consequences. By around 2012 the Chinese were producing some 60 GW Hrs of panels per year, worldwide demand at the time however was only around 40GW Hrs and with the Chinese local and national governments propping up unprofitable companies something had to give and the price dropped well below the 1USD / Watt and has continued to drop even further. This means you can pick up 400+ watt panels for under $250 as opposed to the 1960 price of around $200,000+.

This has created opportunity both in New Zealand and Overseas where large solar farms have been and will be created. (Remember that the Manapouri Power Station has a maximum output of 854MW – (0.845GW)). In Australia recently we passed a solar farm that covered 323 Ha, had installed 373,248 panels and had a maximum output of 149MW. This may seem large but is only a tiddler compared to the largest Solar farm. Installed in India, the Bhadis Solar Park is in the Thar Desert (lots of sunshine) covers 56 $Km^2$, cost 2.2 billion USD and has a maximum output of 2.245GW (about 2.5 times the output of Manapouri) and is well visible from Outer Space. One huge advantage of this large solar farm is that the reduction in dependence of fossil fuels to produce electricity is saving approximately 4 million tonnes of $CO^2$ emissions per year. While this project seems large, India, as of end of June 2023 has installed some 70GW of solar energy around the country. Now compare this with the USA with 179GW, Germany with 81.7GW, UK with 15.7GW, Australia with 34.2GW and China which currently has 430GW of solar installed, (more than 500 times the capacity of Manapouri).

New Zealand is a long way behind the likes of other countries in terms of installed PV capacity. As of February 2024 we have some 400MW of grid connected PV solar, 130MW of that having been installed in the previous 12 months. However, with the cost drop in solar panels interest is growing. There is a new Solar Farm near Ashburton to open soon producing 43MW, New Zealand's largest Solar Farm…. For a very short time that is until a proposed 400MW Solar array opens in the middle of the North island. These two plus the continued uptake by Kiwi Homeowners means that we will compare reasonably favourably with other countries. Comparing capacity with Population we have: China 1MW / 3500

people, India 1MW / 20,000 people, USA with 1MW / 1850 people, Germany with 1MW / 1025 people, the UK with 1MW / 4265 people, Australia with 1MW / 760 people and New Zealand (will have) 1MW / 5,000 people. It is interesting to note that all the other countries listed above have had Government Incentives and subsidies to install solar panels, New Zealand has not. This non-subsidising government policy has been advantageous in that as we expand Tax Payers funds havn't been required for this to happen. Also, with this reducing cost of Solar and new technologies in solar coming online soon I can see a time where our Government will require new builds to have some solar capacity installed similar to the insulation requirement.

For us, having a son-in-law who is a qualified solar electrician has proved very useful when looking at electrical projects. In December 2023 (In Invercargill) he found offering a good deal on 415W Solar panels and flicked us the information. For us the deal was too good to bypass and we decided to create our own Solar Array. 12 panels, 415 Watt each, a 4.98 kW system. (This is currently 0.001245% of New Zealand's capacity!)

Many people mount the systems on the roof of their houses and we certainly have a roof with the right slope. Being in Invercargill we are 46.5ºS meaning that panels set at that angle would produce the best year round output results for a grid tied system, our roof was at 45º, great! However it is in need of replacement, not so great. As we have a long, narrow 1 acre section there was plenty of room out back to mount the panels out of sight and on their own stand-alone frame, the timber for which set the project back about $1100. As we did all the donkey work ourselves over a 10 day period (Plenty of breaks for a cuppa and to do the crossword) including making up the framework, mounting the panels, putting the cabling in place and adding a watering system to facilitate cleaning, it meant it only took a couple of hours for the Electrician to hook it all the electrical stuff together and set it going.

If you were thinking about a system yourselves, you will need an indication of cost. My guess that for a 5kW system you should budget around $10,000 ~ $15,000 depending on how the system is installed and if you get someone else to do all the work. Significant savings can be made by doing some of the work yourself, for us I recon it was about 40 ~ 50 hours which if we had to pay someone to do it would have been $3000 ~ $4000 for time and milage. If you want a smaller system, then that is OK too, costs will be reduced but compliance and inspection costs are the same no matter the size of your project.

In late August with the local supplier going out of the brand of panels we had installed (don't mix your brand and panel sizes, keep them all the same) we purchased 3 additional panels effectively increased our array output to 6.225 kW. Whilst this is a 25% increase the inverter will still only poke out 5kW so there are times on bright sunny days where we effectively have spare output not being able to be used. However, at times of low light and earlier in the morning and later in the evenings we get the full benefit. I have done a rough calculation in that the 25% extra capacity we installed will equate to about a 22% annual increase in power output.

A small note here: As you are aware that you produce a lot more electricity in summer than winter. If you have a standalone system, ie. Not tied to the grid, then to get more effective all year round electricity production the panels should be mounted at an angle of about 60º. This steeper angle aligns the panels more for the winter sun and will assist in the reduced winter solar output from the sun caused by sunlight having to travel through more atmosphere.

In considering the costs to install there are two things. Ground mounted for us the coast was about $1300 in the timber framing and supports. If you are mounting on the roof of your house, you won't have this cost, but you will have scaffolding, required for the safety of those working on your roof.

In putting a system in you need to realise that the dynamics of electricity production and usage don't align 100%. On a nice sunny day in summer we produced 36~40 kW Hr's of energy, we used about 12 ~ 14 kW Hrs and still had to buy some after the sun went down. Most of the days production was exported. On a really cloudy grey day in April we produced 2.8 kW Hr's and probably used everything we produced. Timing your dishwasher, washing machine and other appliances to take advantage of daytime power is a good idea. Also remember that at night when there is no production you will have to suck some power back off the grid to keep your household running. For our system the rate of return on our investment we initially calculated to be around $950 /annum which we thought was quite good. Now, with 10 months of output under our belt we are getting a much better picture of what is going on. For 1st January till 31st October or savings have been almost $1200 and we are now budgeting on a figure closer to $1500 in electricity savings. To make the economics even better we changed our supplier to Meridian Energy as they were offering a 5 year contract of selling us electricity at $0.319/kW Hr, buying our excess electricity at $0.1955 /kW Hr, a fixed daily rate of $0.69 and to cap it off, a $300 credit. Meaning we are currently looking at a saving this year of about $1600 (plus $300 credit) and next year (considering our old supplier was upping the daily rate a further $0.345 a day) we could be looking at around $1700 in savings. (About $150 a month).

This past 10 months has probably been the worst of any for the last few years for sunshine hours, so a La Nina weather pattern this year may well increase our solar output and savings even further. This coupled with expected price rises in Electricity over the next 2 years means we are well placed to keep our costs down and increase those savings.

The chart below is our production, export and Import (kW Hrs to the nearest unit):

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Production | 736 | 601 | 560 | 418 | 317 | 170 | 294 | 474 | 558 | 692 | 4817 |
| Used | 252 | 199 | 246 | 188 | 138 | 95 | 119 | 189 | 269 | 316 | 2010 |
| Export | 423 | 402 | 314 | 230 | 179 | 75 | 175 | 285 | 289 | 376 | 2807 |
| Import | 324 | 270 | 265 | 331 | 352 | 188 | 174 | 373 | 202 | 307 | 2786 |

If November and December's outputs are the same as October then our annual production will be just above 6,500 kW Hrs.

Don't let the fact that places further north have better Solar returns through more sunshine hours. There are some minor advantages to doing solar in the south. PV work more efficiently at cooler temperatures, so whilst Auckland receives about 11% more sunshine, they will only get 9% more production. Also, think of the cost of housing in Auckland v's the cost of a 1-acre section in Invercargill. There are definite advantages down this end of the Country.

The two photo's represent the system. The mounted panels and the Inverter. At the time of taking these photos the output was 5.033 kW. The Panels (DC Output 518.4 V @ 9.5 A) the Inverter output (AC Output 248.4 V @ 20.1 A). Safety First! Never play with the system, let the professionals handle that, 518.4V DC and 248.4V AC would be a definite shock.