Think global, act local: how EVs and rooftop solar can help save money and the planet

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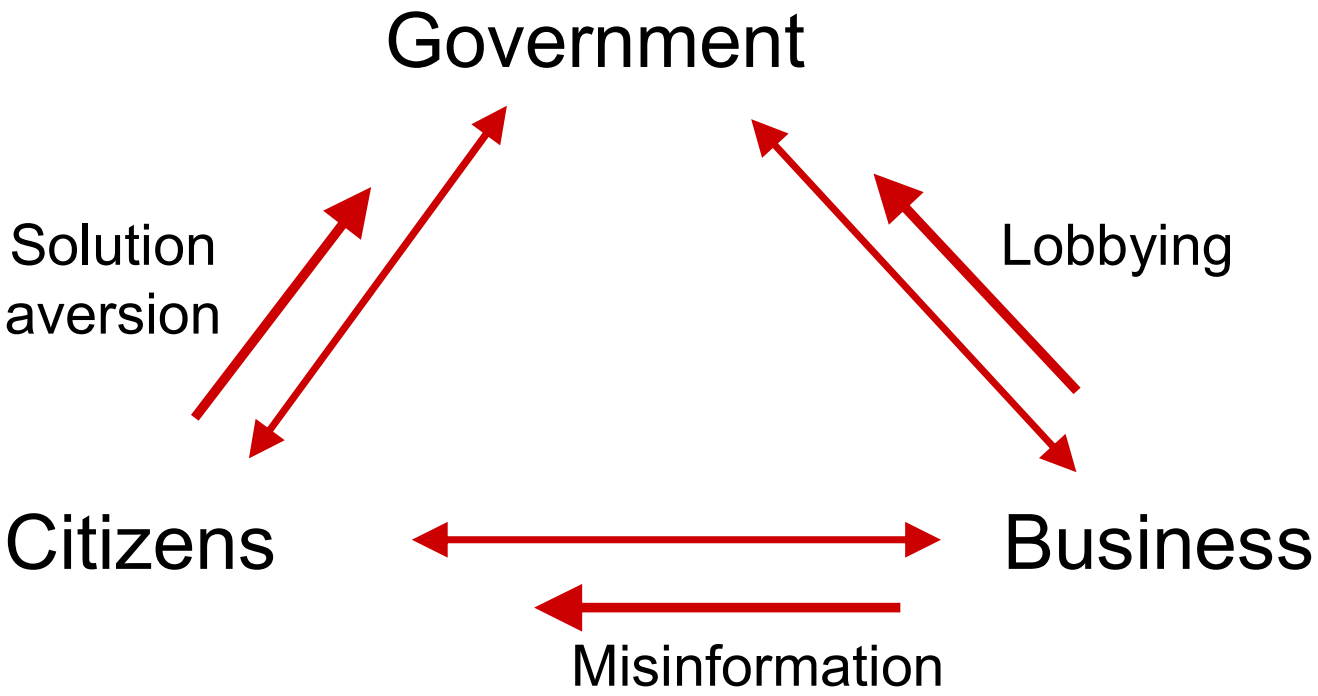
Forest & Bird, 12 November 2024

The big question: climate change

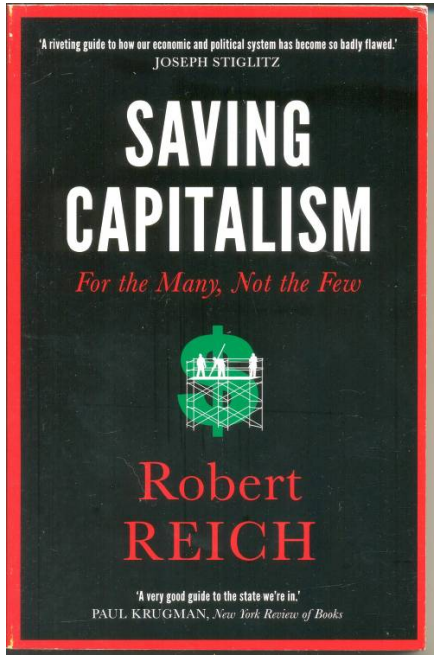
- I usually talk about effects of climate change on ecosystems, gets depressing
- **Why is nobody doing anything?**
  - anything positive, I mean. We are making things worse much faster now
- **How can I help get action taken?**

Why is nobody doing anything?



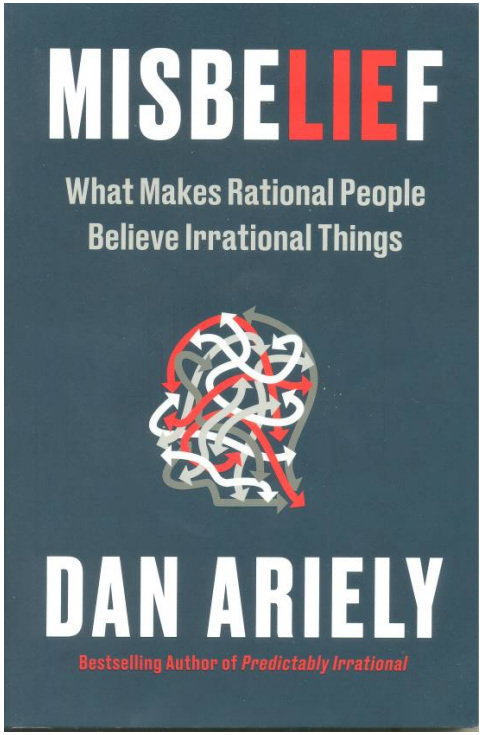
Obstacle 1: Vested interests

- Robert Reich: “free markets” have been increasingly tilted since 1980
- Green economy offers opportunities, but those companies are not lobbying right now
- Rising inequality > political influence > skew rules to suit the rich
  - also harming democracy
- Examples of outcomes:
  - GST not capital gains (tax the poor)
  - Emission Trading Scheme not carbon tax (corporate welfare)
  - NZ electricity system (profit over climate or equity)
    - eg no compensation when power supply fails
    - eg Govt persuaded to let companies raise the 34 c/day fixed charge



Obstacle 2: solution aversion

- Dan Ariely (Misbelief): **solution aversion**
  - If someone thinks the solution will be unpleasant, there's an incentive to decide the problem is not real
  - receptive to misinformation
- This affects what is the best way to persuade others to take action
  - Be positive, not apocalyptic
  - Lower-carbon life is better
  - So why aren't we already doing it?

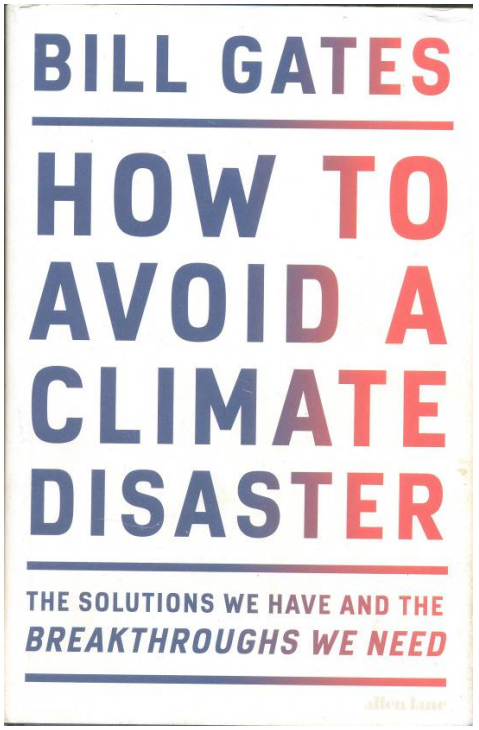


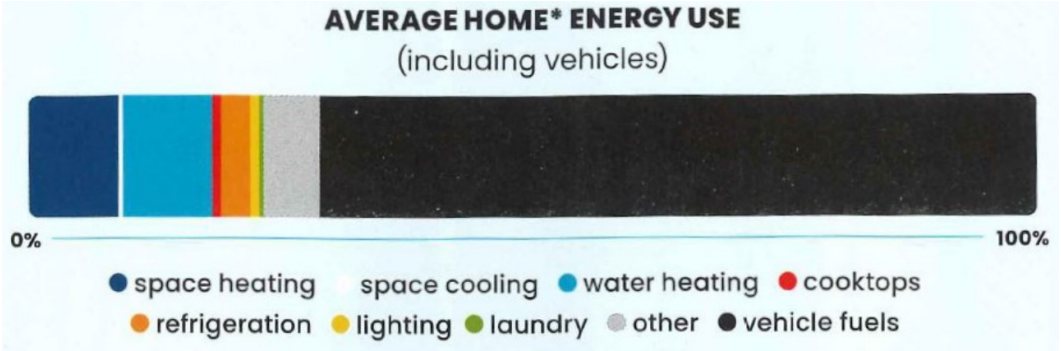
Obstacle 3: misinformation

- Solar and especially EV myths abound
- Source is presumably vested interests aiming to cause confusion, to delay people taking action
- Social media: misinformation is more profitable
- That's the reason for this talk
  - dispel myths, people get good solutions, they tell their neighbours, everyone votes for parties committed to climate solutions
  - complete climate solutions must be political and regulatory

Priorities for action

- People are paralysed by bad news if there's no obvious action
  - need "agency" (Amanda Ripley, Washington Post 8/7/2022)
- Focus on big things first (Bill Gates)
- Biggest items in personal carbon footprint: flying, driving, food, electricity
  - www.carbonneutraltrust.org.nz is OK





Average NZ household energy use is 70% for car fuels: Consumer issue 264

What I will cover

- EV environmental impacts, myths, and how to use EVs
- How solar generation works, cost and environmental impacts
- Further resources

Disclaimers

- I have no commercial stake in any of this
- Won't suit everyone depending on your situation (somewhere to charge EV, energy use, roof shape, access to capital)
- Prices change constantly
- Solar carbon-cost savings depend on assumptions on alternative generator type, dry vs wet year

EV myths 1: distractions or out of context

- **Useful reality check: does anybody ask this for petrol cars?**
- Poor people can't afford a new EV
  - they drive smaller cars; the rich emit far more carbon
- EVs will strain the NZ electricity system
  - our EV (our only car) uses 1600 kWh/year
  - this raised our home electricity use 14%
  - small towel rail 700 kWh/year
  - small, large fridge 1200-2000 kWh/year
- You need a fast home charger
  - Consumer: "A wall socket will struggle to fully recharge a large battery overnight … why wait when you could charge 3X faster with a 32-amp wall charger?"
  - Answer: because you don't recharge a large battery every night, and the fast charger costs $3000

700 kWh/yr

1600 kWh/yr

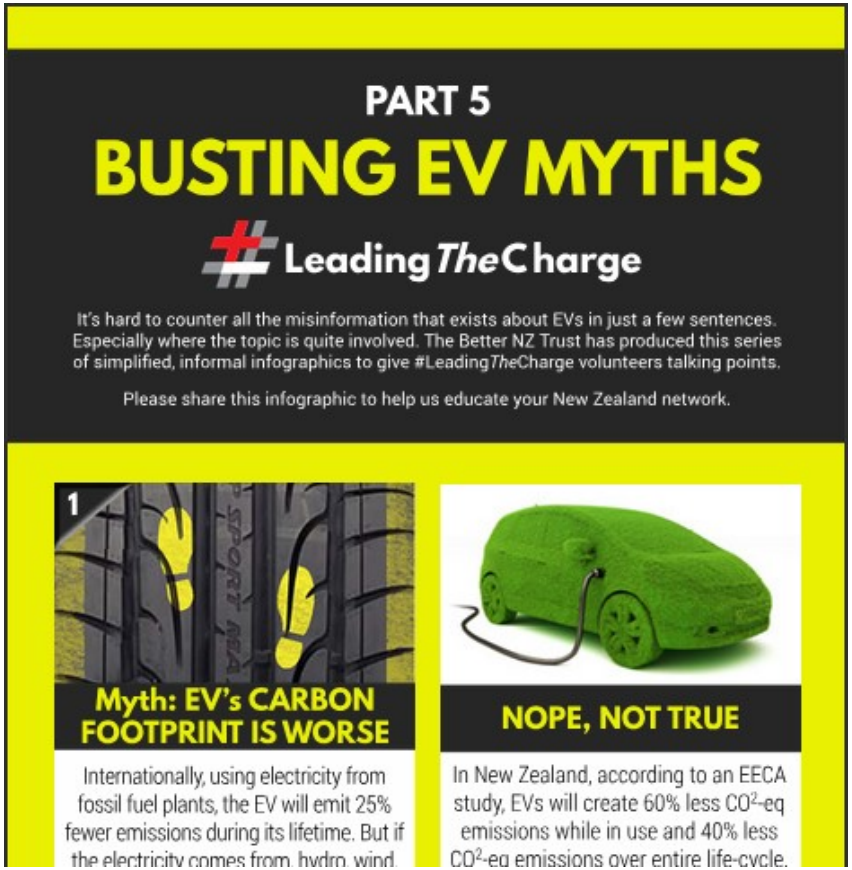
EV myths 2: really weird ones

- EVs more likely to catch fire
  - **petrol** cars are 11 times more likely
- Use “six times more minerals than a petrol car”
  - that number excludes steel and aluminium!?!
  - including those it’s only 23% more, all recyclable
- Cobalt mined by child labour
  - not used in latest batteries, can be recycled. What about oil?
- Extra weight of EVs will stress roads, parking buildings
  - never raised for SUVs
- Greater non-exhaust emissions
  - What the??? SUVs, regen braking. What about exhaust emissions?

More info: mythbusters, and EV expo

www.guardian.co.uk/mythbusters

Leadingthecharge.org.nz/about-us/busting-myths/



Free Expo on soon, see the real thing

Three questions non-EV owners ask

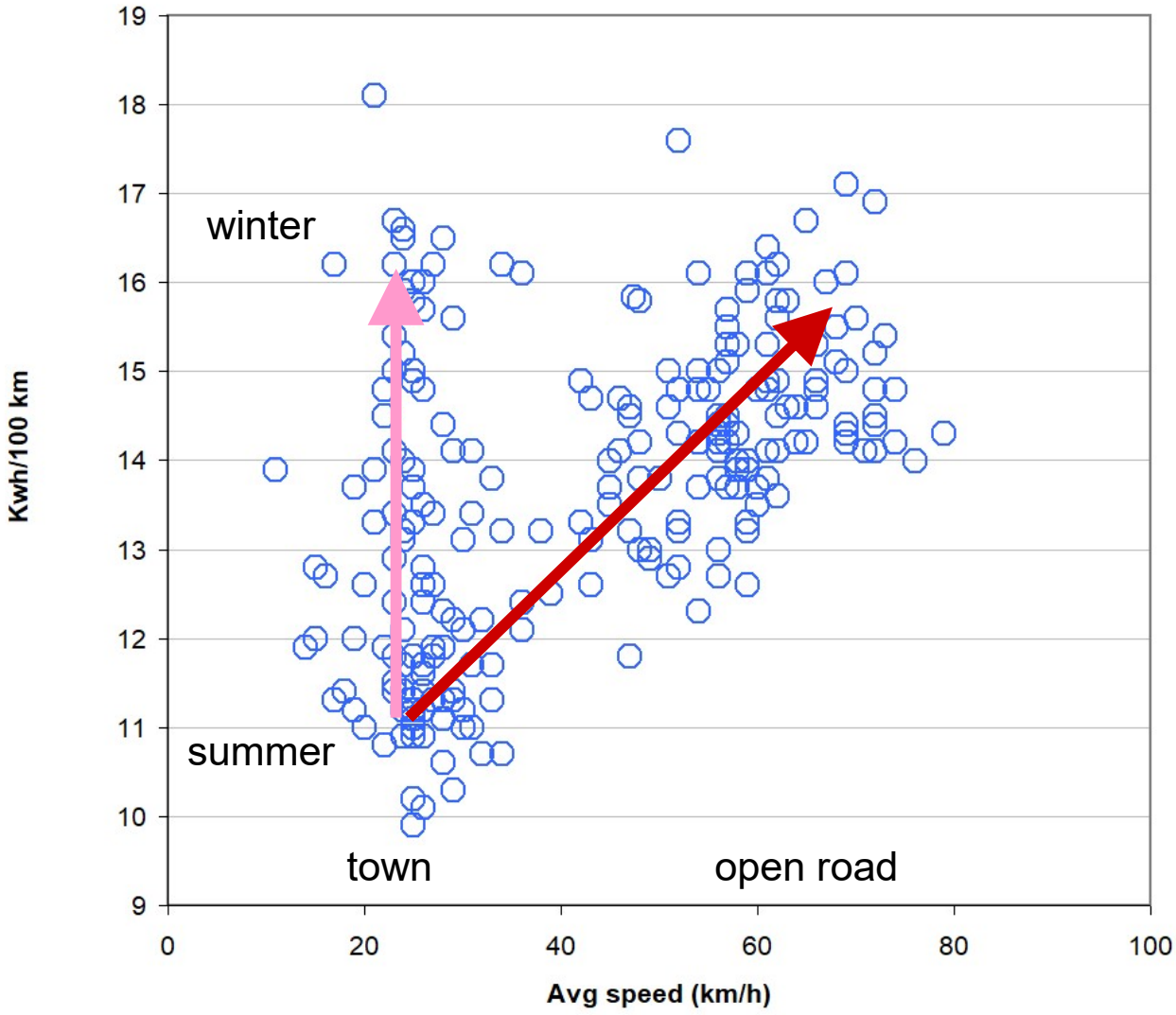
- What is the range?
  - use more on open road than in town
  - never go 100% to zero
  - practical question: maximum range on the open road from 85 to 15%
- How long does it take to charge?
  - not one big charge, usually small top-ups
  - normally at home overnight when needed
  - open road: drive 2 hours, stop for coffee, car is recharged before you have finished drinking it
- How long will the battery last?
  - USA study: batteries are nearly all lasting the life of the car

Range varies with speed and season

Trip average speed and average electricity consumption in our Peugeot e208 EV

Major trend: faster trips use more (petrol cars do the same)

Minor trend: winter uses more for heater, but only on short trips around town (petrol cars use ‘waste’ heat, where two-thirds of the petrol energy ends up)



Three less obvious points about EVs

- The cheapest, worst EV is a really good deal for two-car families
  - a range of 100 km is more than most people drive 95% of the days of the year
- Batteries over 50 kWh are a (costly) luxury
  - see above re time to drink a coffee
- Fast chargers are not used often, and the fast charger network is good
  - last year we drove 7700 km out of town, requiring 29 fast charges, total cost $288
  - only gaps: Springs Junction, Haast

EVs are just better cars

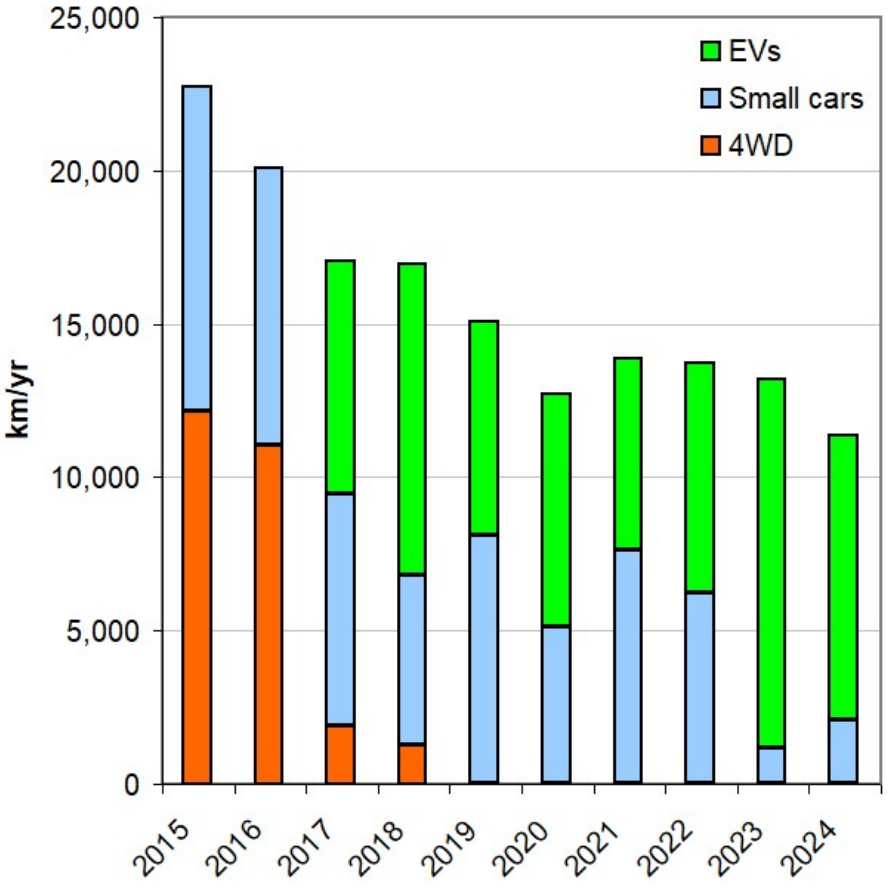
- Quiet, reliable, few moving parts
- No local air pollution
- Use less fuel around town
- Regenerative braking
- Good for towing
- Fast (to ludicrous) acceleration
- Refuelled in your garage overnight with NZ-produced fuel (your own roof?)
- The only things they can't do
  - drive for 8 hours without stopping
  - wake the neighbours
- EVs are clearly the car of the future (it will not be hydrogen)

The cost of EVs

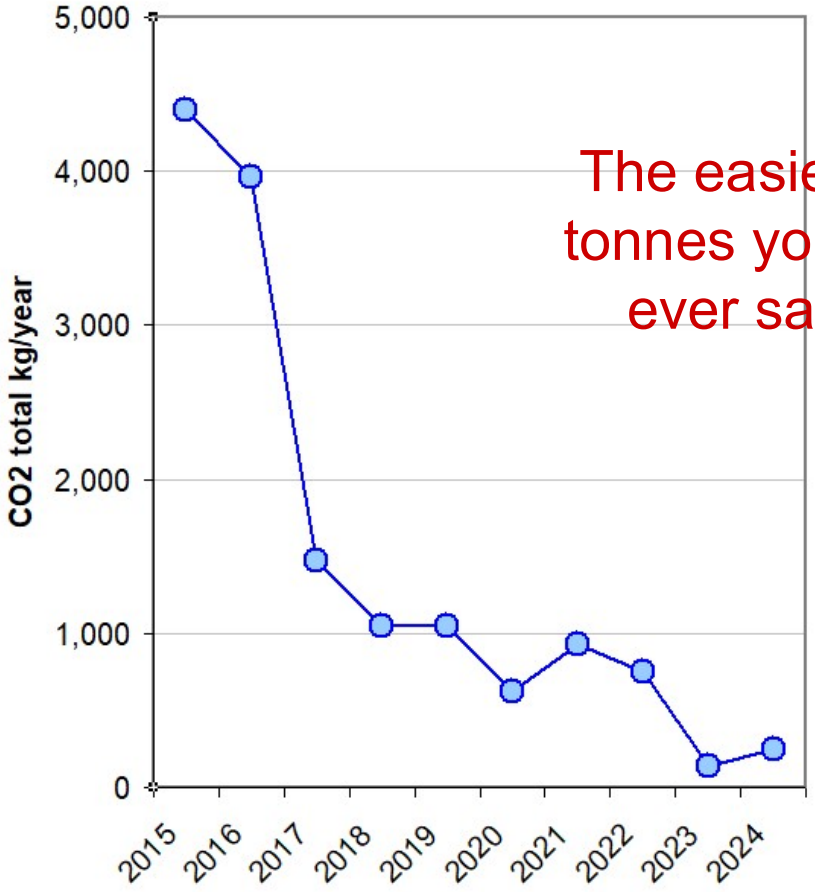
- Changes all the time
- Purchase price: rebates or not, second hand market
- Recharging: home vs fast charge, electricity prices
- Servicing: low cost
- Road User Charges: since April 7.6 c/km for EVs
  - that's twice the 3.6 c/km petrol duty paid by a small petrol car
  - diesel utes require subsidy for Government 2030 NZ carbon offsets
- Our current EV averages 2 c/km for electricity, plus RUC totals 9.6 c, less than our last small petrol car at 13 c/km

Consumers Institute says over 5 years, an e-Mini is still cheaper than petrol Mini even with added RUCs and no rebate (issue 264)

Our carbon reduction!



We went from 4WD plus small car, to small car plus EV, to now just an EV. Recent average 13,000 km/yr



The easiest 4 tonnes you will ever save

Total CO2/year down from 4.3 tonnes to about 0.2 tonnes (this year zero)

The carbon footprint of NZ electricity

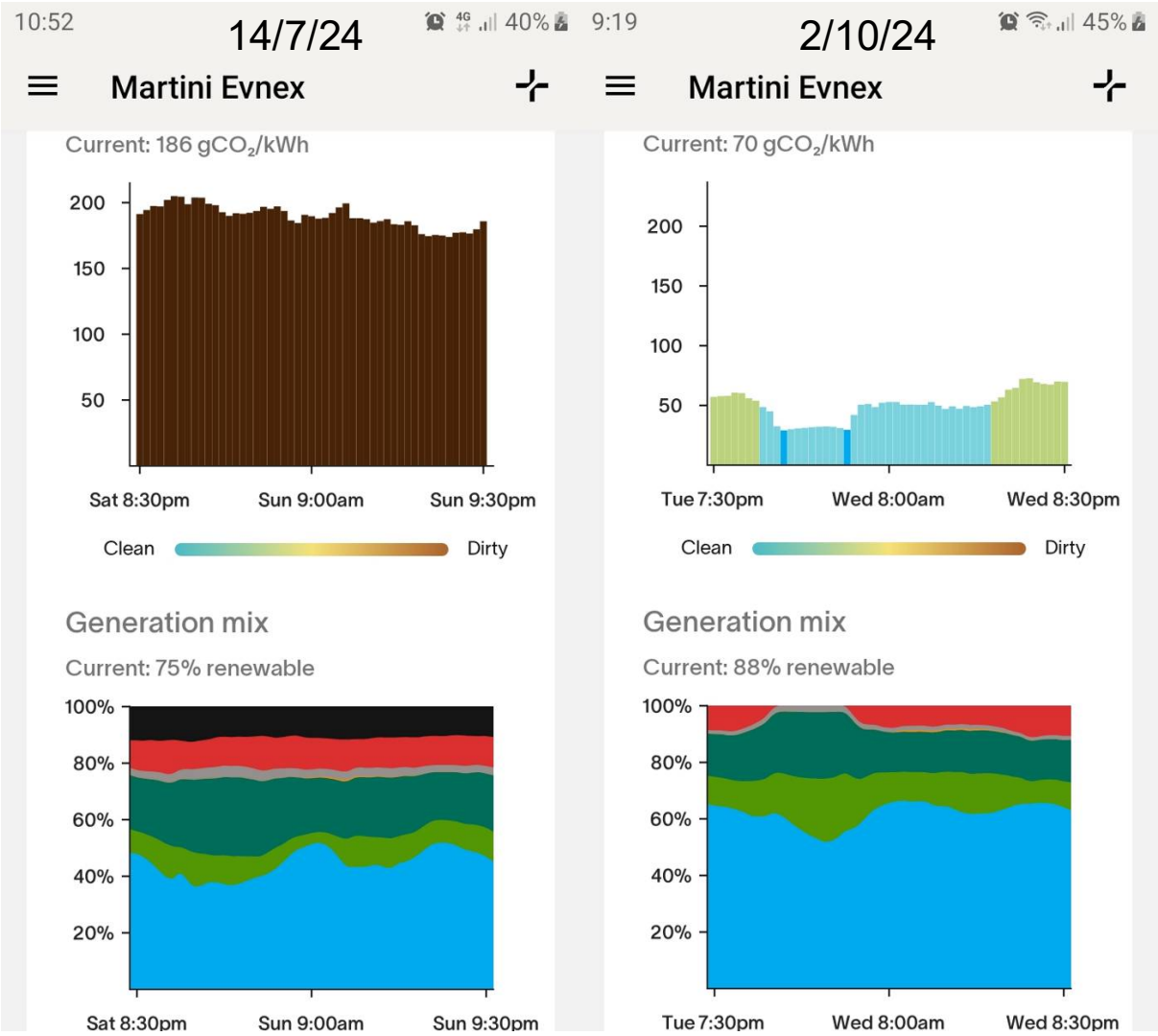
Those numbers assume electricity in Chch has zero carbon footprint

Evnex app shows NZ average varies widely from 30 to 200 g CO2/kWh (5-30 g CO2/km)

Debates about South Island vs North (no thermal generation in SI)

Why is coal still burnt in NZ?

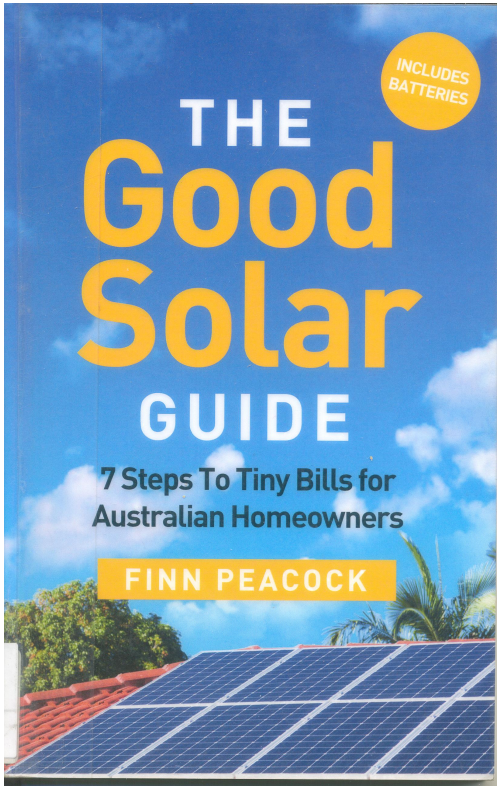
What can you do about it?



Possible reasons for getting solar power

- Ethical/Environmental
  - we are in a climate crisis
  - if solar electricity is lower carbon, that is a real benefit
  - the NZ electricity market is dysfunctional (carbon)
- Economic
  - financial return is important, but not the only reason
  - how fast will a renovated kitchen pay for itself?
  - the NZ electricity market is dysfunctional (cost)
- Technical
  - just love the technology
- Emergency preparedness
  - keep the lights on in a power cut?

See Finn Peacock book



Solar electricity vs solar hot water

Solar electricity
(solar panels, photo-voltaics, PV)

Electricity can be used for anything
No moving parts, long lasting
Price has dropped ~90%

Solar hot water

Only heats hot water
Pumps, pipes, higher maintenance
Used to be cheaper but PV now better

Key environmental questions (benefit to NZ)

- Carbon cost of home solar vs grid electricity
  - panels cover their carbon cost in 2-3 yrs*, run for 25
- Three key constraints on the NZ electricity system:
  - **total energy** use per year (kWh)
    - local solar generation probably reduces Huntly use of coal
    - within each day, if you don't have a battery, hydro easily covers solar imbalance in time of generation vs time of use
  - **peak power** demand on winter evenings (kW)
    - no change without a battery, reduced if you have a battery
  - **transmission** of electricity from generator to user (cost and energy loss)
    - local solar reduces demand on long-distance transmission lines

*if replacing coal

First you need a roof: three key factors

- Normally fitted on house roof (can be garage or shed, rarely the ground)

Orientation

Ideal: North

Real world: east and west are nearly as good

Slope

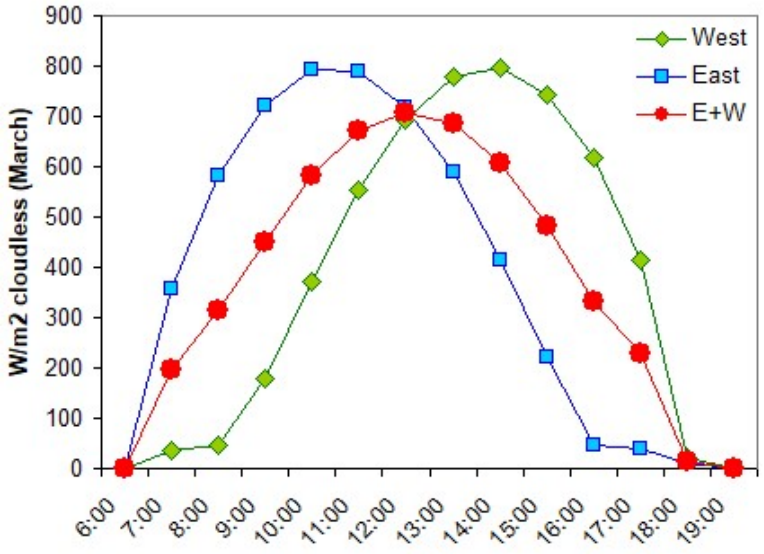
Ideal: 47°

Real world: almost any slope is OK. A flat roof will need brackets ($)

Shading

Ideal: no shade

Real world: **major shade is a big problem**. Minor shade can be mitigated with extra hardware ($)



How it works: plain solar (no battery)

- Solar panels generate DC electricity
- Inverter turns DC into AC and feeds it to the house
- By day, panels run house and may export to grid
  - depends on amount of sunshine, size of panels, and demand in house
- At night, house draws from grid

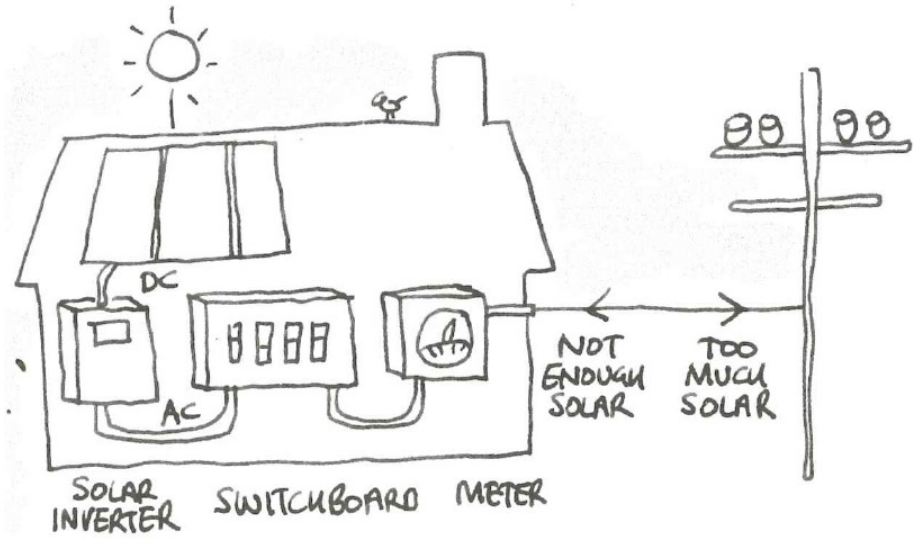
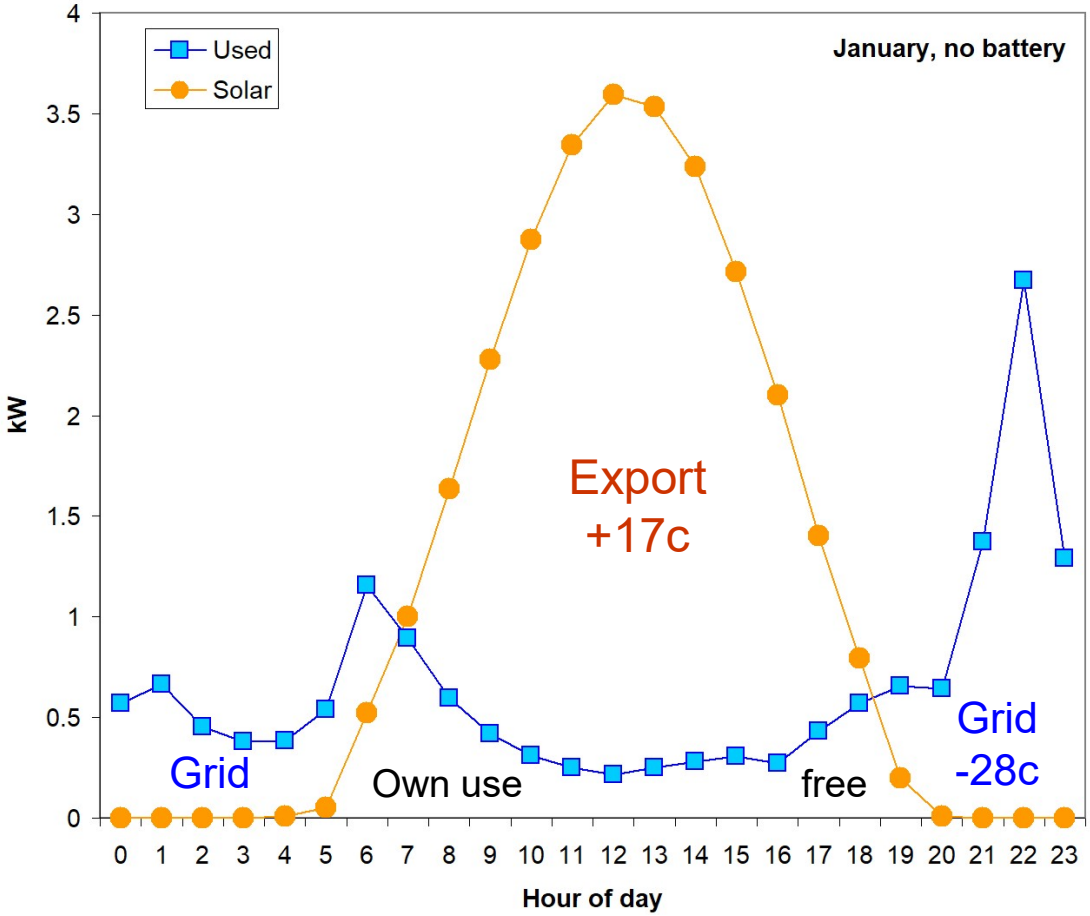


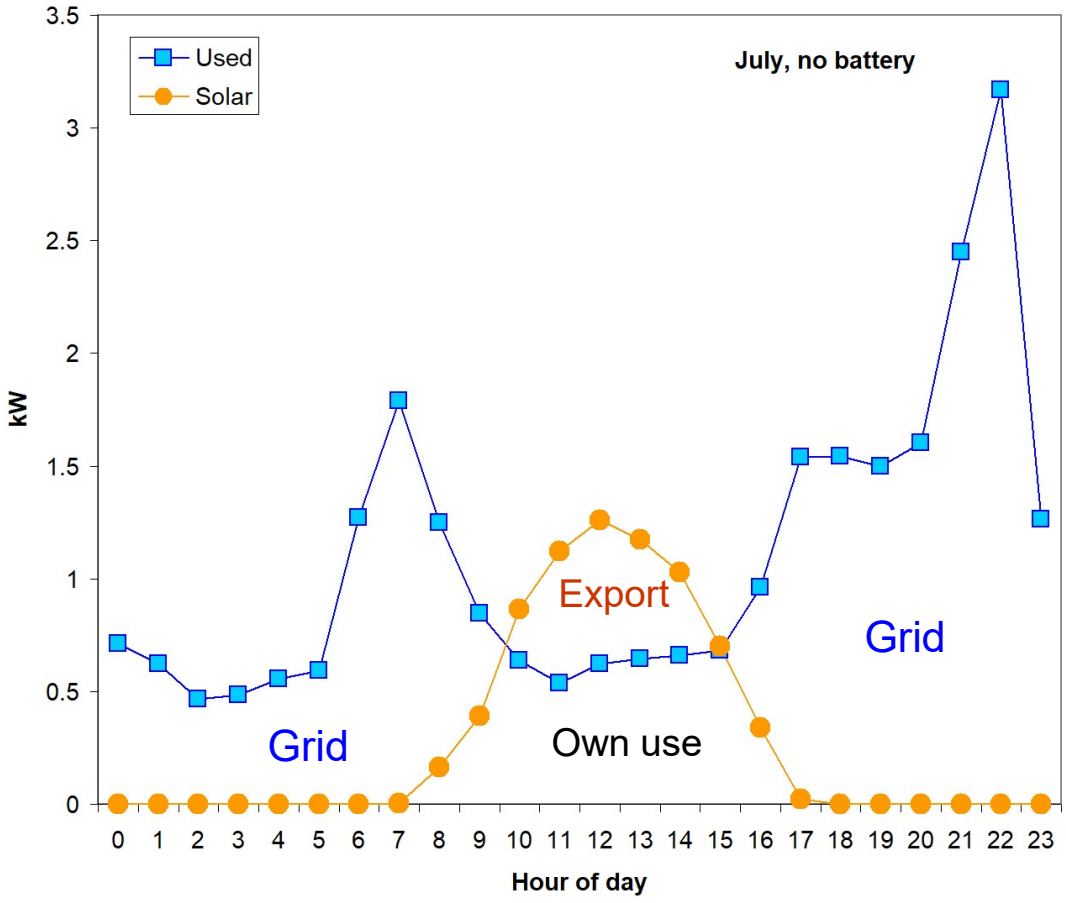
Figure 1.9 An on-grid solar system.

from The Good Solar Guide

Plain solar PV (no battery)



Summer: generate more, use less



Winter: generate less, use more

(Meridian solar rates)

Annual net cost/benefit (no battery)

Key factors affecting economics of plain PV system:

- How much daytime electricity you use (e.g. hot water timer)
- How much you **earn for exports** (solar), and pay for imports (grid)
- Best to be on a flat-rate plan, with same cost per kW at all times of day

An example (estimated for our system without the battery)

- 6.1 kW-peak panel setup costing $12,500
- Generation 6,800 kWh, house consumption 6,400 kWh per year
- Saves 600-1200 kg of CO2 a year (cf NZ average generation)
- Own self-consumption 24%, export +17c, import -28c (Meridian)
- Annual bill $2040 without solar, $720 with solar, saving $1320/year
- Pays for itself in 9.5 years; rate of return on capital **10% after tax**
  - return improves if power prices rise

Conclusions: plain solar

If you have a suitable roof :

- Increases NZ sustainable generation, lowers your carbon footprint
- Reduces power bills with 10% rate of return
- Can be set up any size (less than, or more than, your house uses)
- Fit and forget – no moving parts
- Panels should last >25 years, inverter ($5K) maybe 10 years
- You can add more panels later to a small PV system, if your roof has space (at first install make sure inverter has spare capacity)
- You can add a battery later to a plain PV system

- Some PV systems will not run when the mains are off! Discuss with salesperson if emergency preparedness is important

How it works 2: solar with battery

- Solar panels generate DC electricity
- Inverter turns DC into AC and feeds it to the house and/or the battery
- The battery saves solar (or grid) electricity and releases it later
- By day, panels and battery run house
- System only exports when battery is full
- At night, system only imports from grid when battery is low
- So within limits, when you use electricity and when you generate (or buy) it are decoupled
- Batteries used to be prohibitively costly

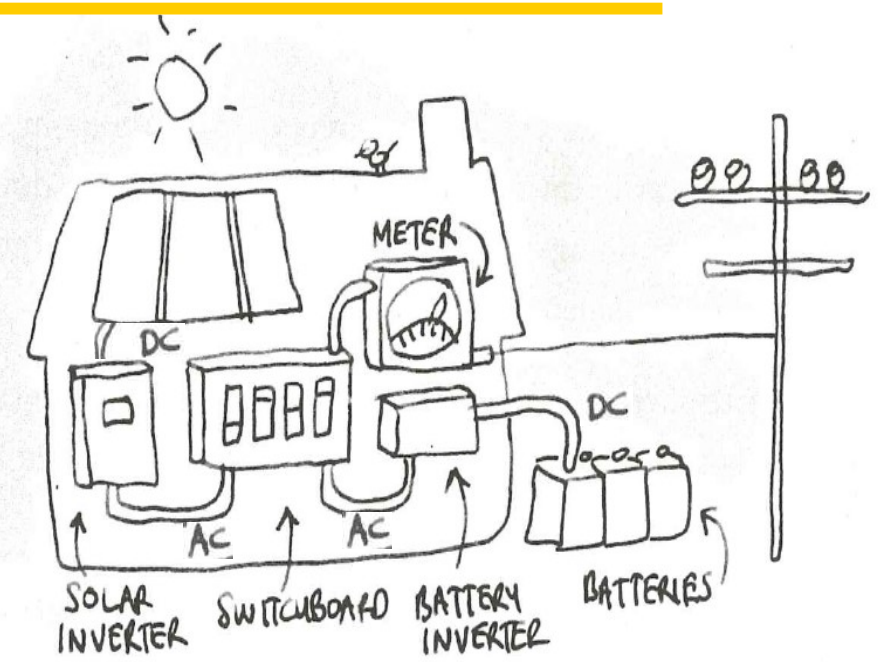


Figure 1.10 Hybrid solar system is an on-grid solar system with batteries.

from The Good Solar Guide

Benefits and costs of PV with a battery

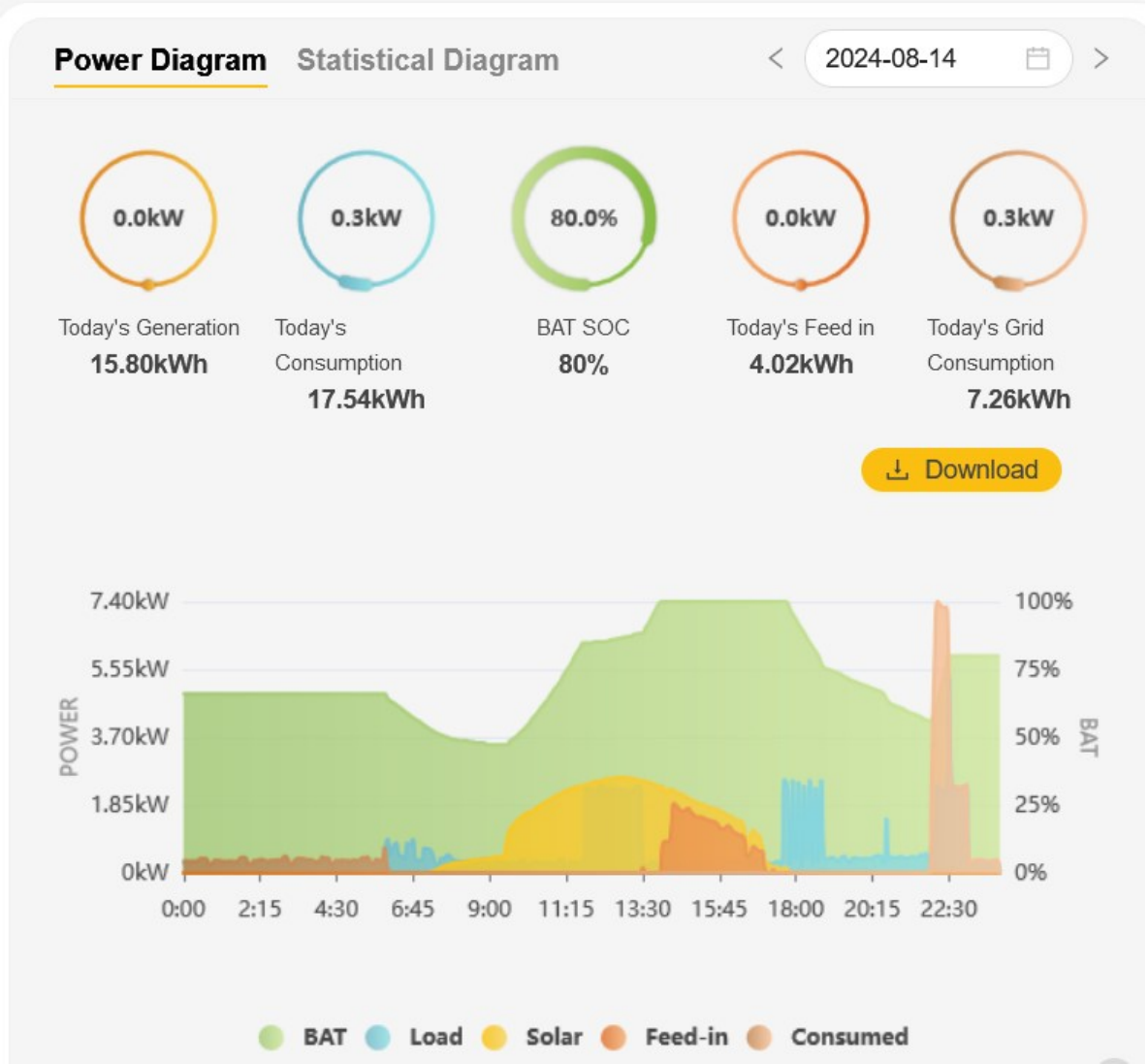
- With a battery, it's best to be on tarrifs that vary by time of day

Benefits of the battery:

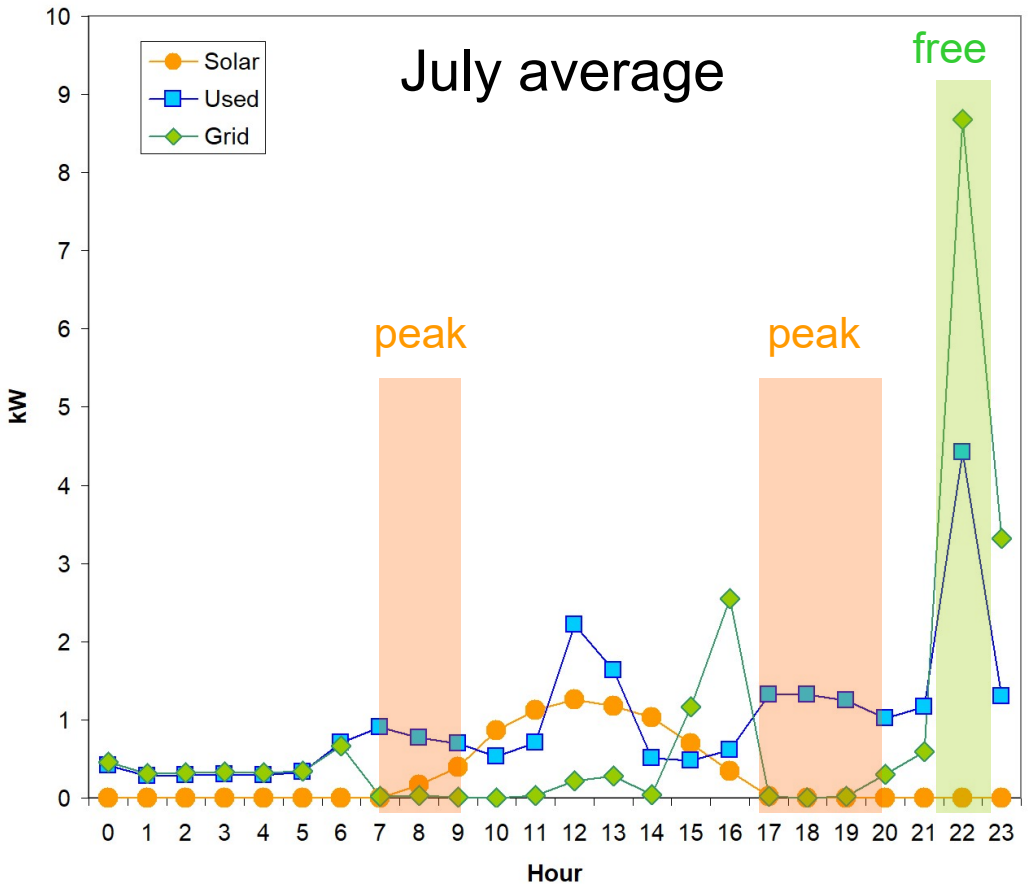
- you can use more of your own solar
- you can buy electricity at cheap times, use it at expensive times
  - this lowers your cost of grid electricity, especially if you have a power retailer with a "free" hour (we are with Electric Kiwi)
- you can avoid using the grid in peak demand periods morning and evening (a benefit to NZ, and saves you $)
- in a power cut, your house keeps a (modest) electrical supply more or less indefinitely (again, verify with salesperson)

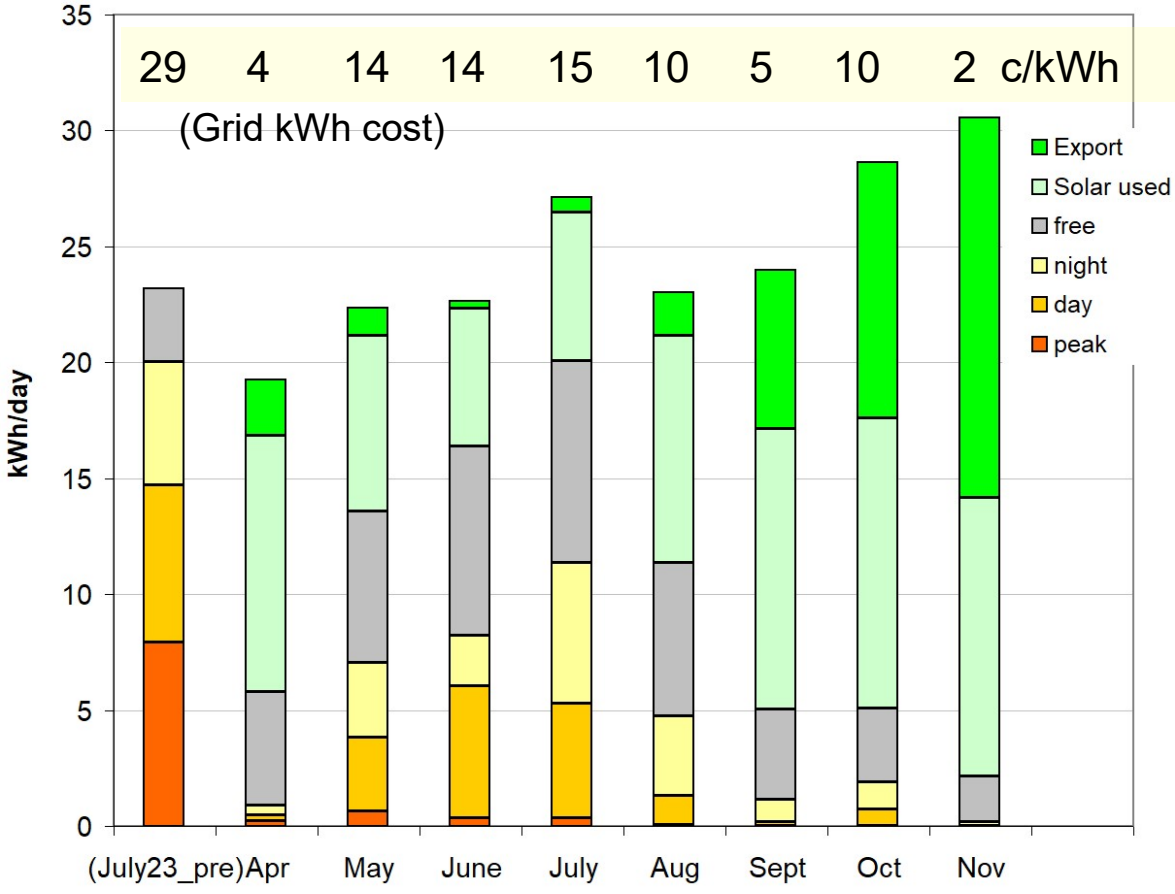
Drawbacks: extra cost and embedded carbon, battery might only last 10-15 years

An example: one day on our solar app



Time-shifting within a day = cheap grid electricity



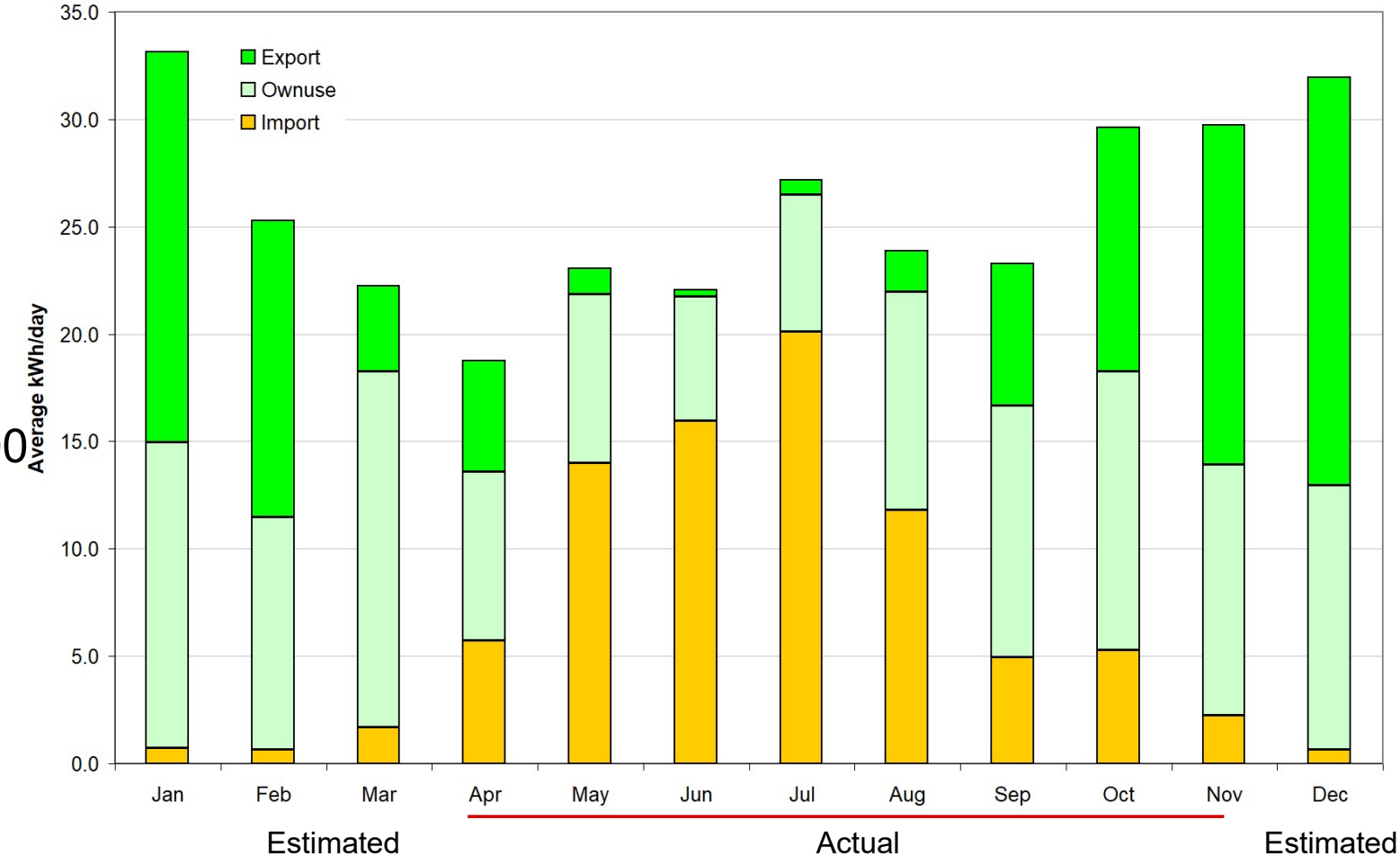


We buy essentially no peak power, but get lots when it's free 10-11pm

April-mid Nov our electricity is 46% free solar, 30% free from grid, 1% peak

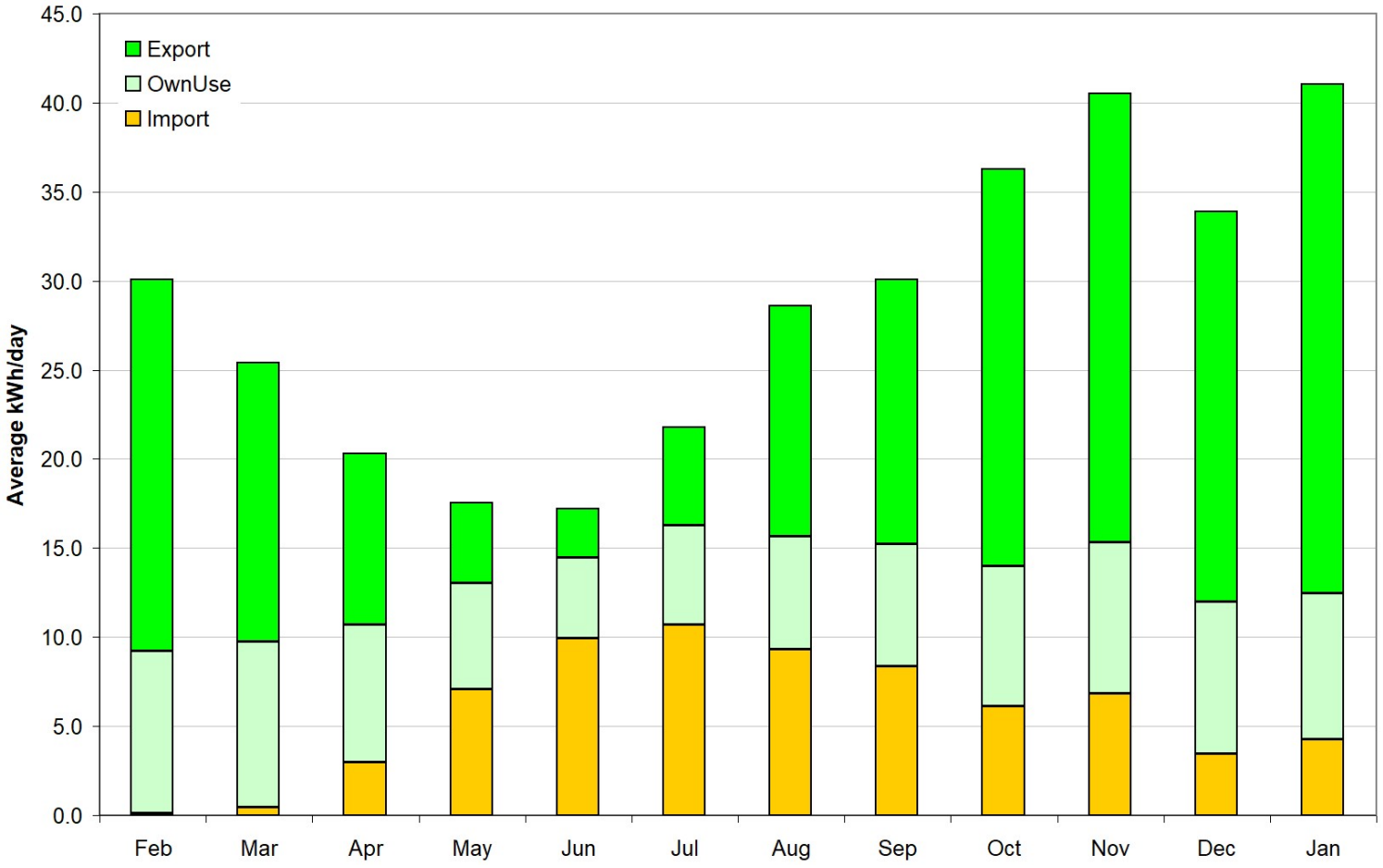
Monthly generation and annual cost 1

- Our house (2 people, no wood fire, EV)
- 6.1 kW panels, battery
- System cost $21,500
- Generate 6,850 kwh
- Use 6,400 kwh
- Bill without solar $2,100
- **Bill with solar $130**
- Savings $1,970/year
- Payback 11 years
- Rate of return 9.1%



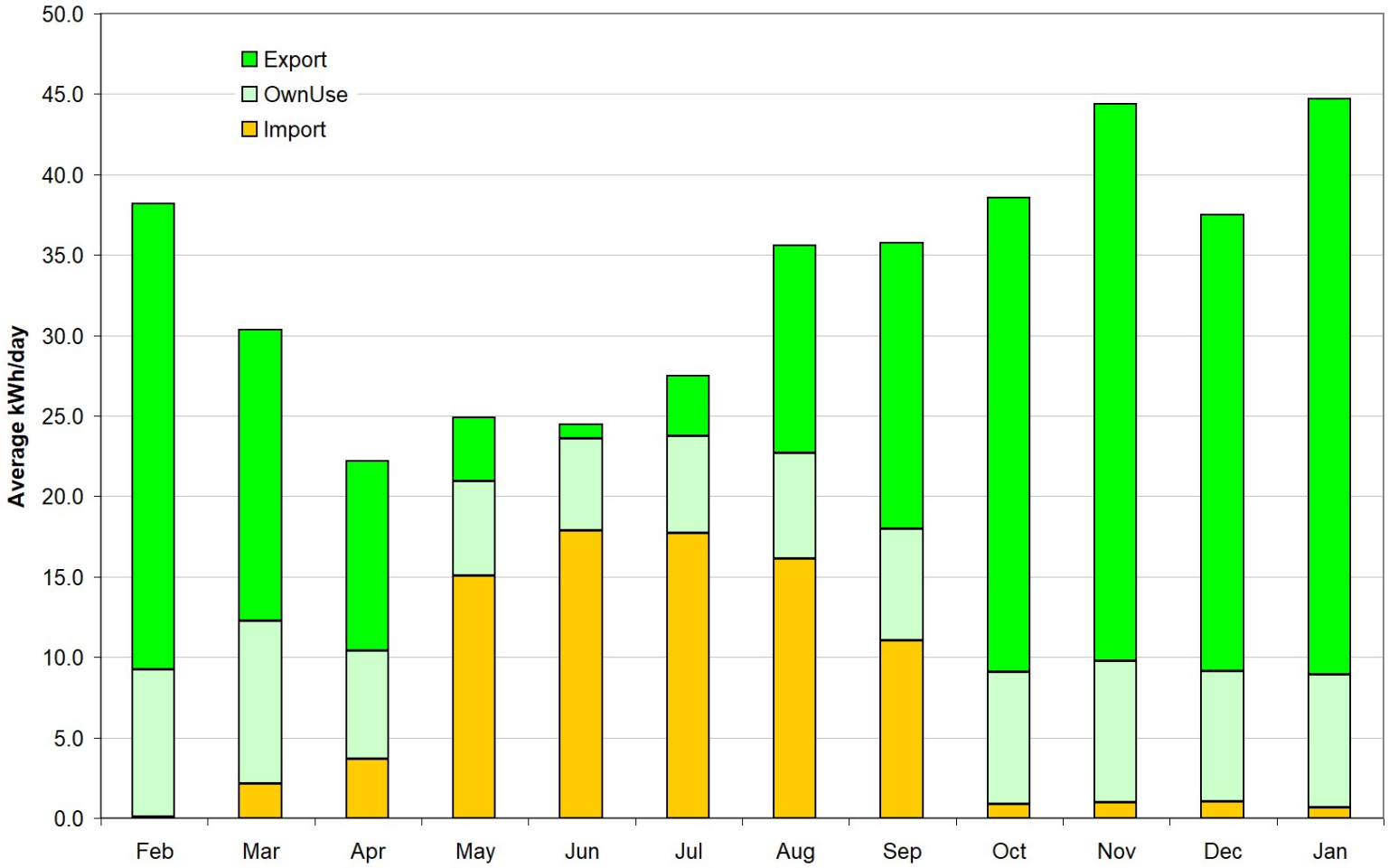
Monthly generation and annual cost 2

- BA house (2 people, wood fire, no EV)
- 7.2 kW panels, battery
- System cost $24,500
- Generate 8,300 kwh
- Use 4,800 kwh
- Bill without solar $1600
- **With solar -$511 credit**
- Savings $2,100/year
- Payback 12 years
- Rate of return 8.6%



Monthly generation and annual cost 3

- SR house (2 people, wood fire, no EV)
- 9.0 kW panels, battery
- Cost now $27,000 (was $35K when installed)
- Generate 9,700 kwh
- Use 5,400 kwh
- Bill without solar $1,750
- **With solar -$700 credit**
- Savings $2,450/year
- Payback 11 years
- Rate of return 9.1%



Summary of battery PV systems

- These three households are all low user, energy conscious, two adults (though ours includes an EV)
- Prices change all the time (of installation, of grid and export electricity, between power retailers, etc)
- At current rates, large reductions in annual power bills
  - 6.1 kW $130 cost per year (for house using 6,400 kWh/yr)
  - 7.2 kW $511 refund
  - 9.0 kW $700 refund
- All give around 9% return on investment **after tax** (~12% before tax), assuming power prices do not increase 😂
- On pure economics, no other safe investment pays that much
- Solar financed on your mortgage gives electricity at 11.5 c/kWh, one-third of the grid average of 34c (The Press, 28/8/24)

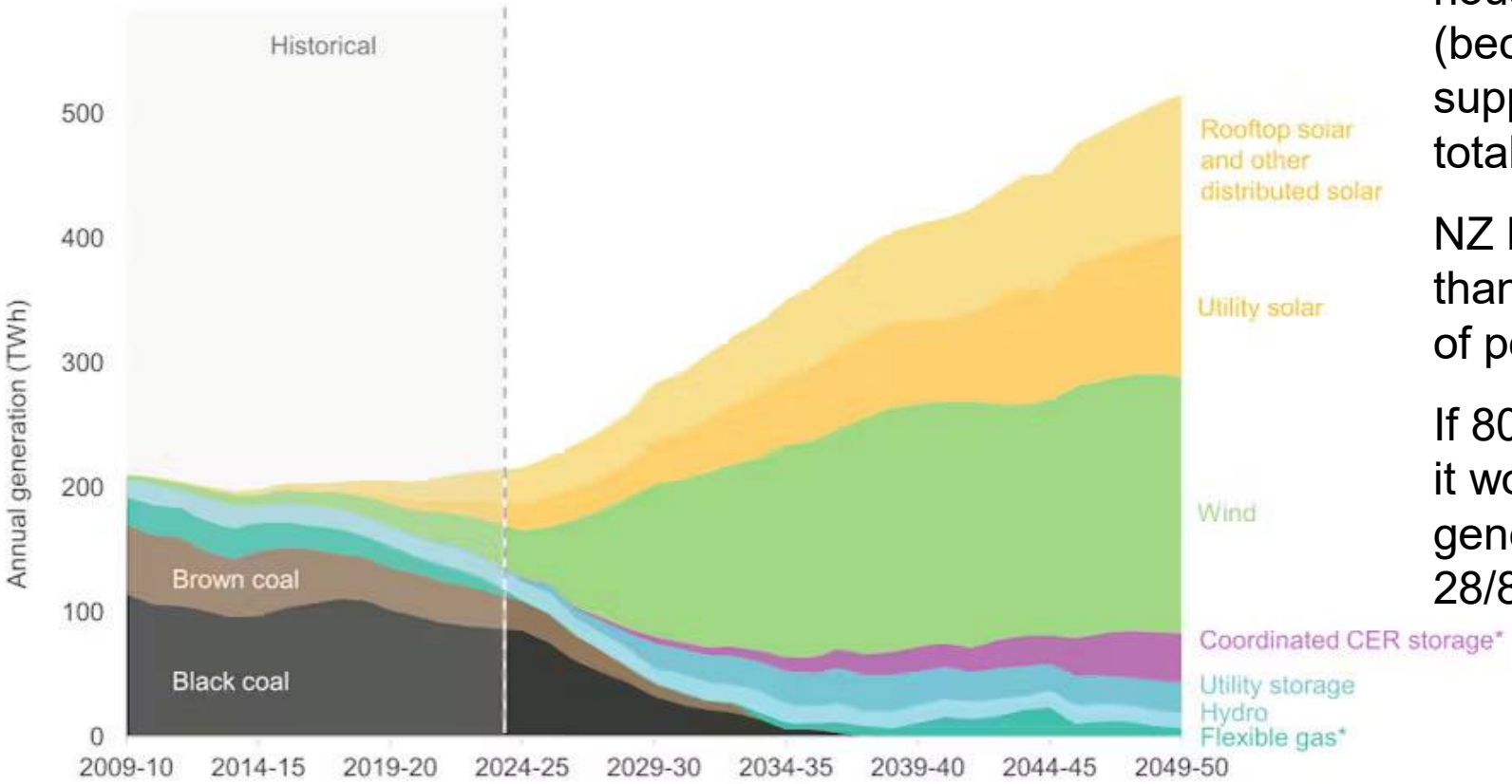
Environmental benefits

- Both plain and battery systems save carbon (around 1-1.5 tonnes/yr for the three examples of medium-large panel setups)
  - compared to current dry-year NZ average of 100-180 g CO2 per kWh
- Battery systems reduce peak demand
- Better than large-scale solar farms: uses roof space not agricultural land, no need for long-distance transmission, no CEO salary

Mackenzie Basin solar farm proposal

Environmental benefits: looking forward

Australian electricity forecast



Notes: Annual generation for 2023-24 has been estimated for the full financial year.
Flexible gas includes gas-powered generation, and potential hydrogen and biomass capacity.
"CER storage" are consumer energy resources such as batteries and electric vehicles.

Australia has 35% of households with rooftop solar (because of government support), generating 11% of total electricity

NZ has 3% of houses and less than 1% of total generation, lots of potential.

If 80% of NZ houses fitted solar it would increase total generation 40% (The Press 28/8/24 and 9/11/24).

The Conversation, article 219714

Some solar questions

Do I have to stay in my house for 10 years till it's made a profit?

- If you own the solar, the resale value of the house should be higher ("this house has no power bills"), as good or better than any other renovations ✔

What if I don't have the capital?

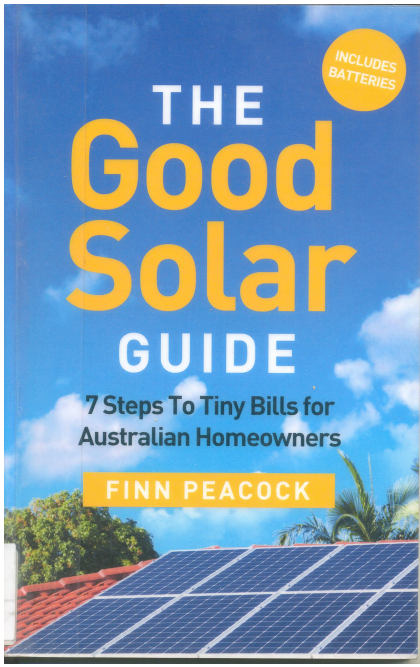
- Green loans from various banks: loans up to $80K for sustainability projects, 0-1% interest for 5 years (so you earn 10% on their money!) ✔
- Solar Zero rental solar: they pay for (and own) the system and charge you a monthly rental for 20 years, while you pay smaller power bills. ✖
  - Consumer NZ say "If you sell your home after the system is installed, the new owners will need to take on your agreement, or you'll need to pay out the remainder of the agreement or have it moved to your new place (assuming it's suitable for solar). It could make selling your house messy and expensive."

Solar conclusions, and further resources

- Once it was “almost impossible to disconnect from an electricity grid that runs partly on fossil fuels” (Washington Post): no longer
- I expected that solar would have environmental benefits and marginal economics, but the economics are also very good
- Solar is now cheaper and greener than the NZ grid
- Emergency preparedness: off-grid operation rarely needed
  - until the Alpine Fault goes
- Which company: pick one that sells good-quality components, provides after-sales service, and will still be here in 10 years
  - we used **Sunshine Solar**

Further info: Finn Peacock, The Good Solar Guide, 2018

- NIWA solar calculator solarview.niwa.co.nz
- email me: dave.kelly@canterbury.ac.nz



Priorities for action revisited

- Aim for better, not perfect
- Technology alone won't fix it
- reduce, repair, reuse, recycle = do less, save money
- move closer > walk, cycle > bus, train > EV >> fly
- Both rooftop solar and EVs are educational and encourage moderation, and save significant carbon with little pain

Overall conclusions

- The only time anyone asks about carbon or financial payback times is when you are trying to be more sustainable
- The problems raised about EVs are never raised for petrol cars
- Not as much misinformation (yet) about solar
- We are saving about 3-4 tonnes CO2/yr with EV and around 1 tonne with solar
- Both EVs and solar are worth doing - and you'll feel better
- Do it and tell your friends: the personal is political

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