Getting off Gas: Solar and Air Source Heat Pump - the numbers

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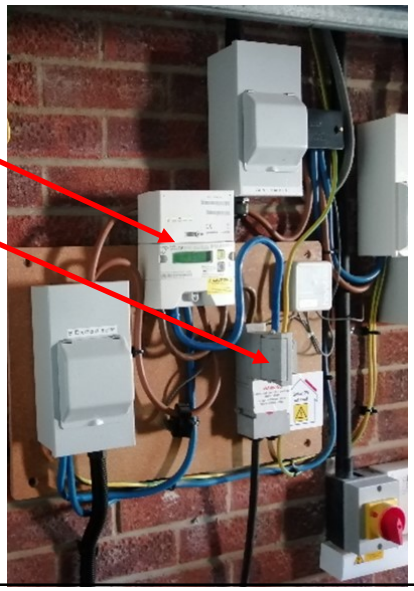
Resident of Martlesham Heath, Ipswich

Timeline

- House built in 1983, bought in 1992
- House fully insulated over the years – loft, walls, windows, doors
- Changed to Electric vehicle (Renault Zoe) in April 2019
- Fitted own Zappi charger plus solar panels in October 2019 (East)
- Smart meters fitted December 2019
- Additional solar panels (West) and batteries in October 2020
- Air Source Heat Pump (ASHP) fitted in December 2020
- Induction hob fitted November 2021, gas disconnected

My solar and ASHP installation

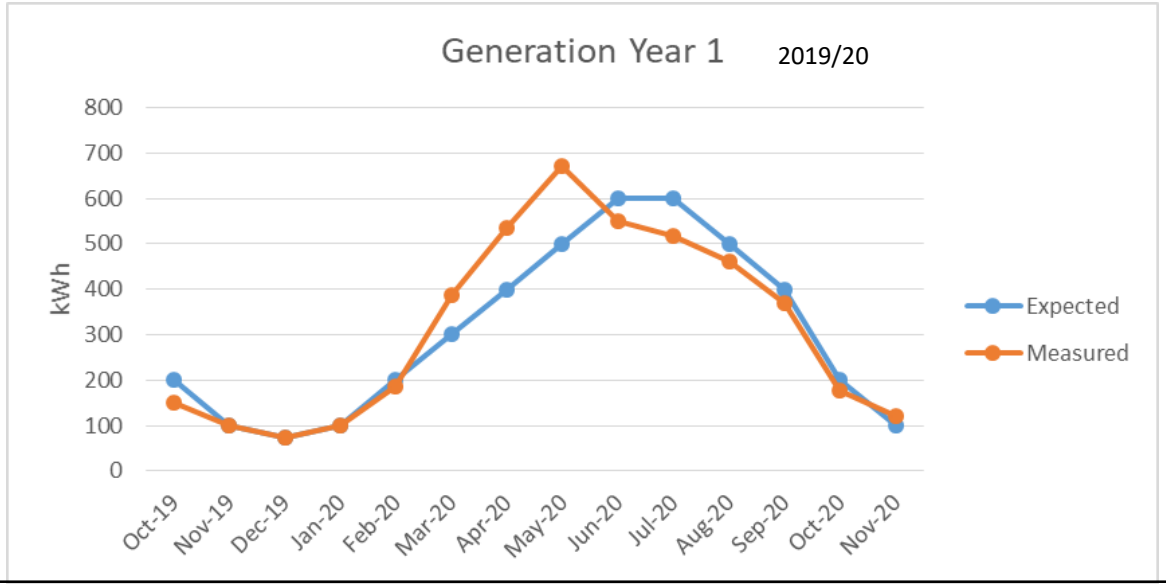
- Smart meter
- 100 amp fuse



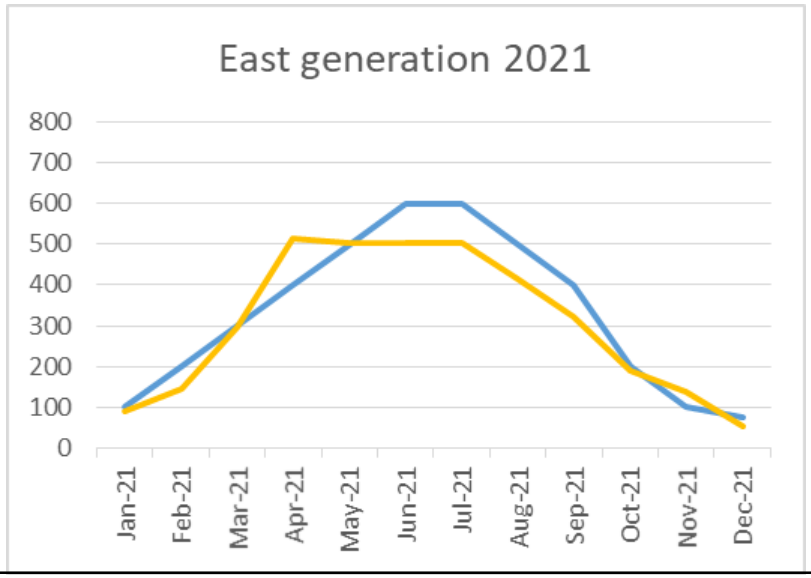
East solar panels – Oct 2019

- Size: 14 panels, 4.6 kWh at peak times
- Solis inverter
- Cost: £5,900
- Original estimate was @60% utilisation = 11 years payback at 15p/kWh
- Electricity prices are rising, utilisation improving, so payback earlier

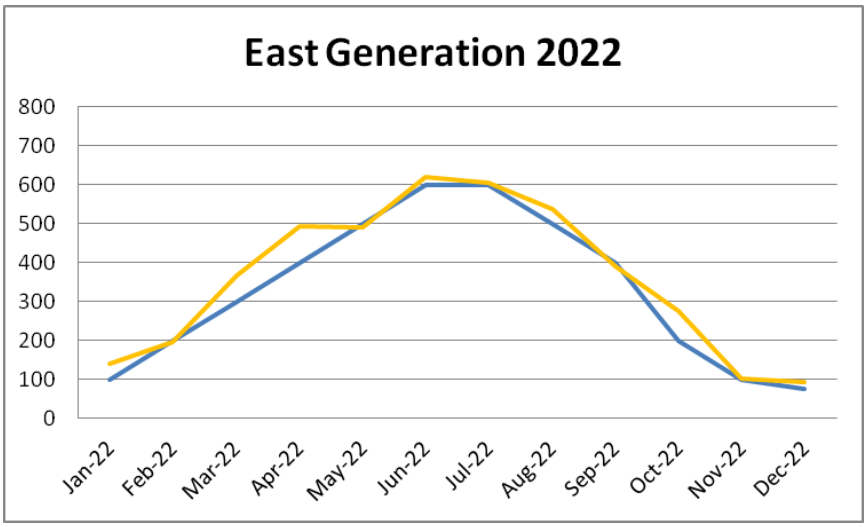
East gen 4000 kWh generated vs 3500 est.



East panels Year 2 3670 kWh Actual vs 3975 est



East gen Year 3 4300 kWh actual vs 3975 est

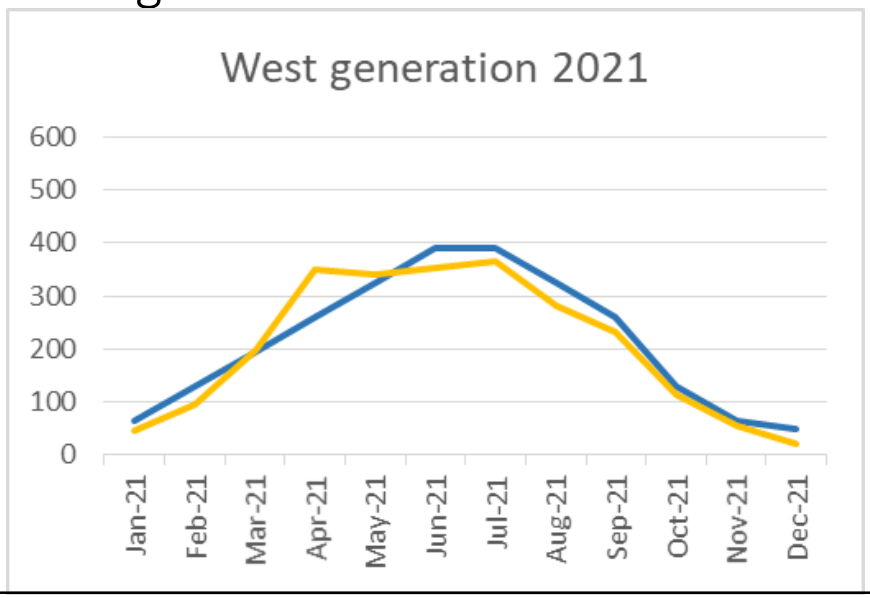


West solar panels - Oct 2020

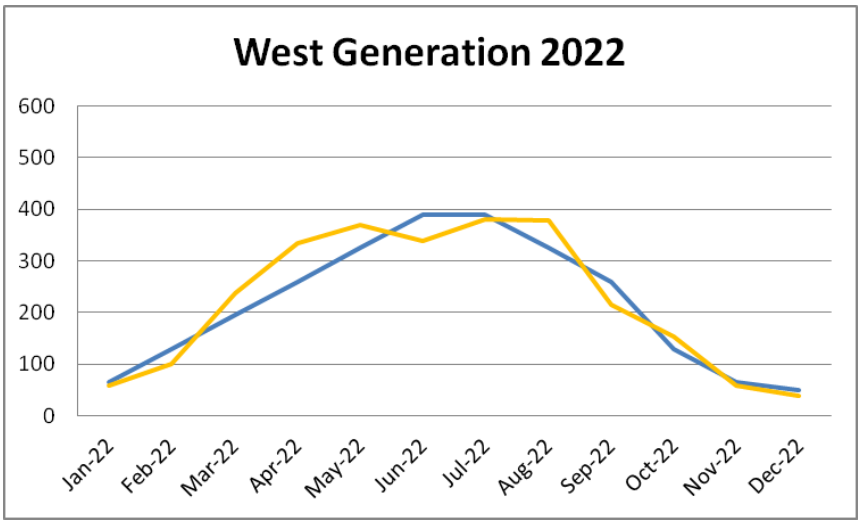
- Size: 12 panels, 4 kWh at peak times
- Solax inverter plus 12.6 kWh batteries with battery management system
- Cost: £9,500

- Battery is key, coupled with cheap off peak electricity, to make economics work when changing from gas to electric heating
- Battery can be programmed to charge off peak

West gen Year 1 2455 kWh actual vs 2585 est

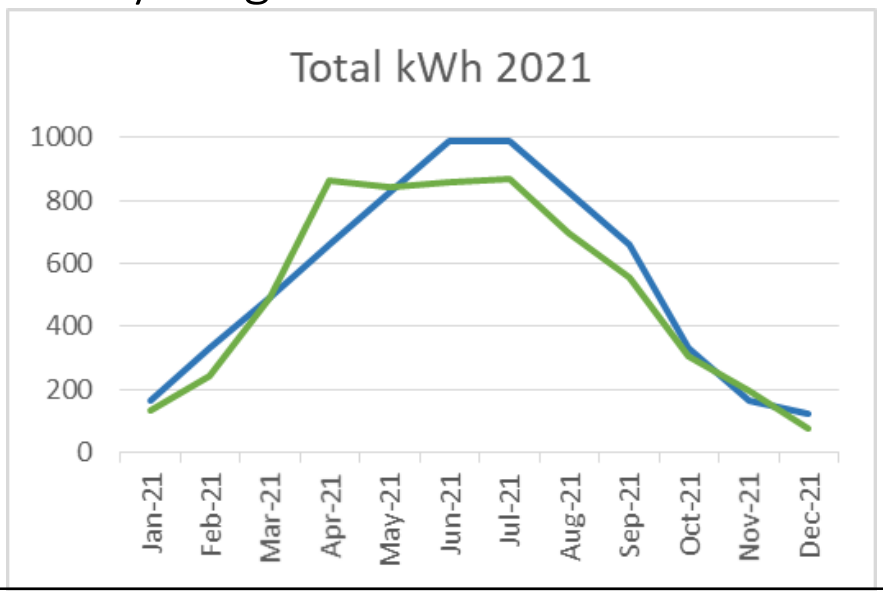


West gen Year 2 - 2666 kWh actual vs 2585 est



Totals

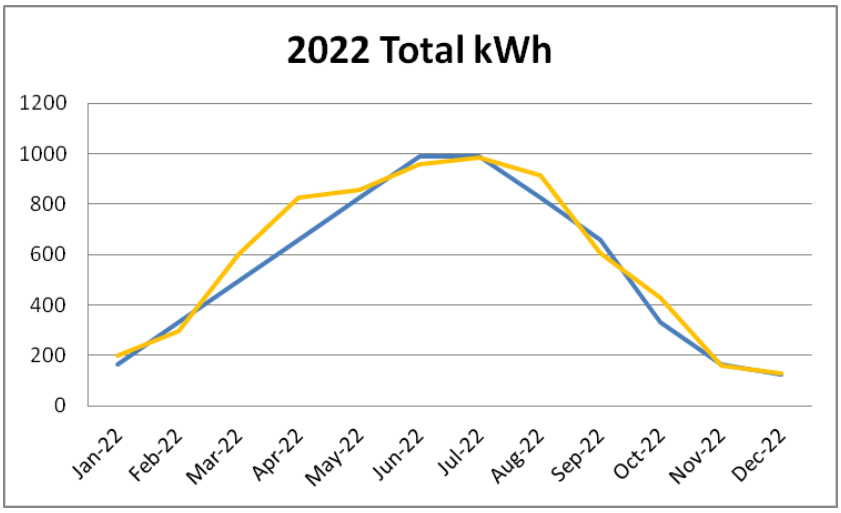
Total year generation vs estimate kWh



Actual 6125 kWh

Est. 6560 kWh

Total year generation vs estimate kWh



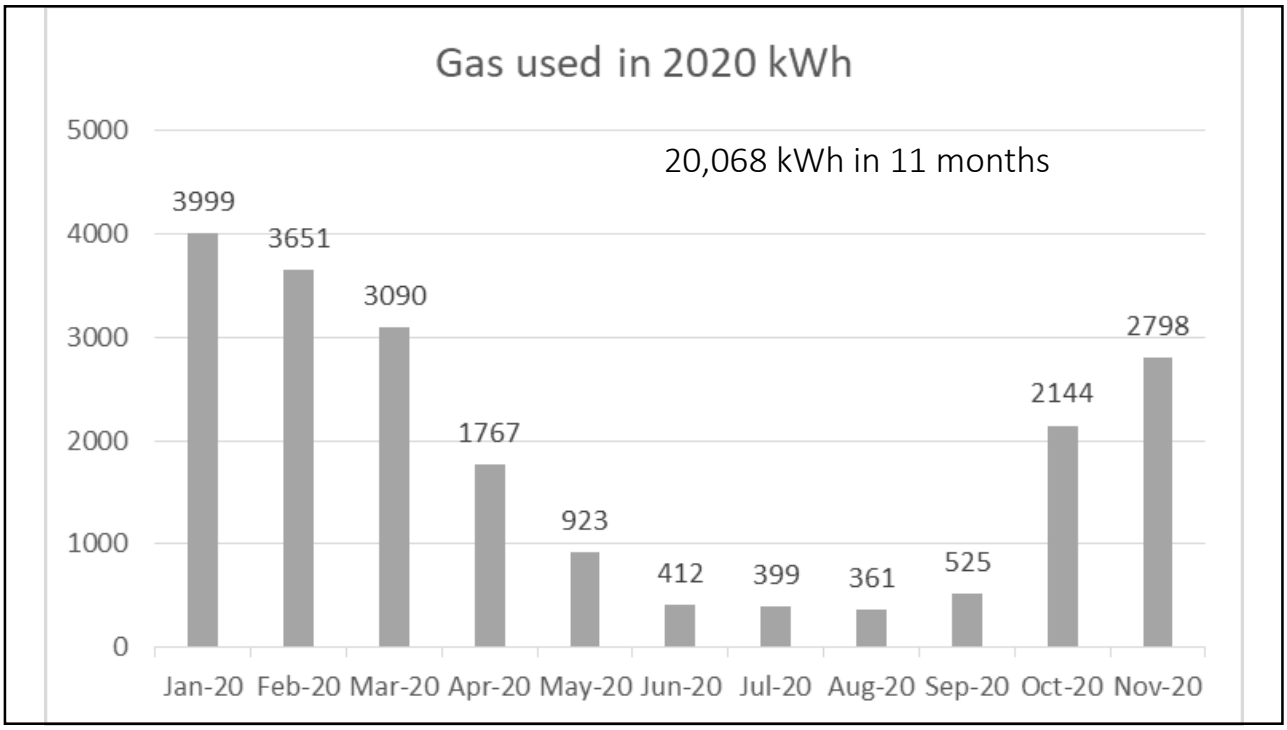
Actual 6966 kWh

Est. 6560 kWh

Old gas system

- Original gas boiler – inefficient, due for replacement
- High carbon emissions
- Hot or cold rooms! Never just right
  - Controlled by fixed thermostat in hall

- 4/5 bedroom house, floor area 170m^2
- Energy Performance Certificate (EPC) numbers:
  - Heating: 17,121 kWh per year
  - Hot water: 4,376 kWh per year
  - **Total:** **21,497 kWh per year** (+ some gas for cooking)

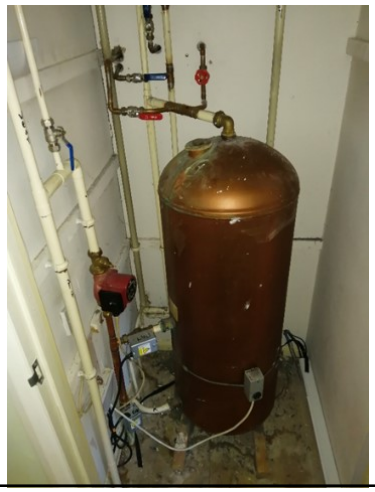


ASHP

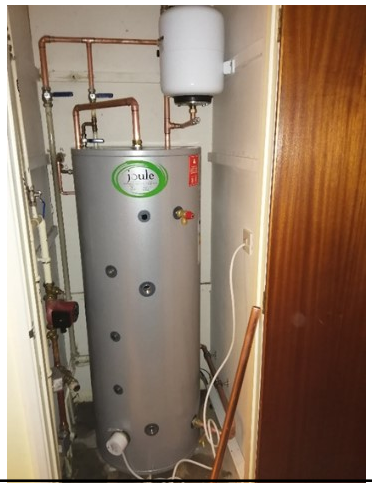
- Size: 8.5 kWh output
- Cost: £14,600
  - ASHP, HW tank, 6 new radiators
  - Used existing pipework
- Renewable Heat Initiative (RHI) subsidy repays £11,400 over 7 years
- One week to install in December 2020 (Hot water functional on day one with immersion)
- Controlled by mobile thermostat (19^{o} day, 17^{o} night)
- Hot water tank heated at 1 a.m. when heating is generally off anyway

Hot water system

- Old tank – no immersion



New – HW pressurised = better showers



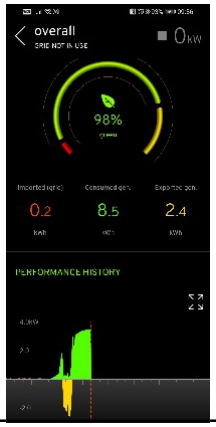
Buffer tank in loft, cold water tank removed

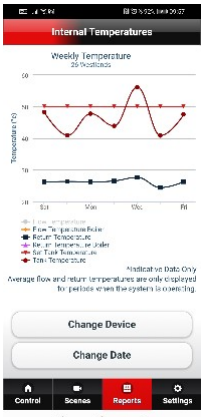
The ASHP

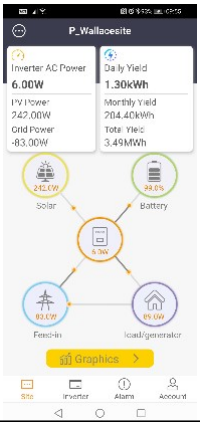
- Very quiet
- North facing (OK although not optimal)

Data

- All connected to the internet
- App controls –MyEnergi, MEL cloud, Solax, thermostat control



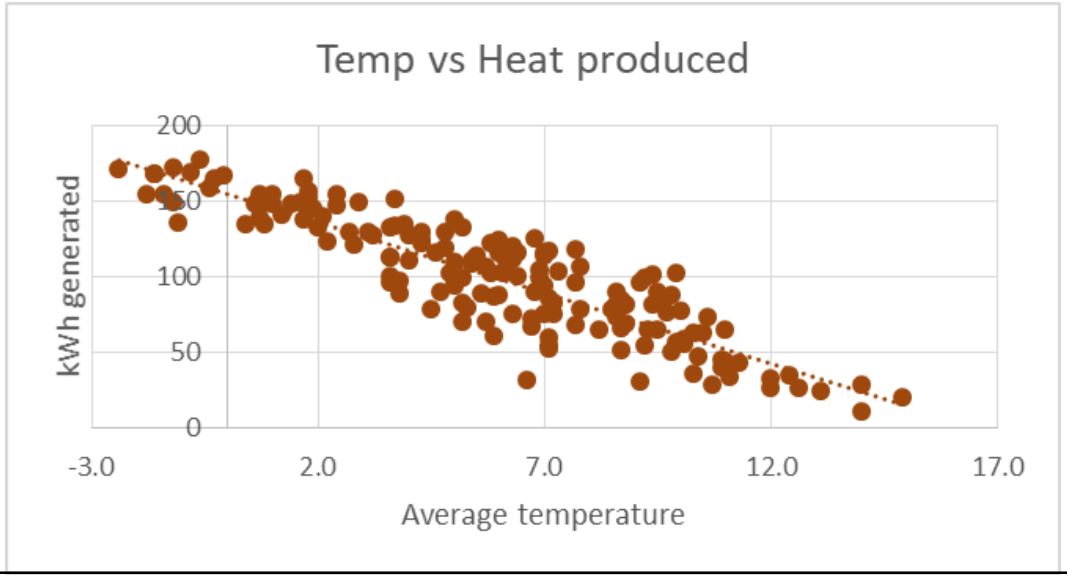




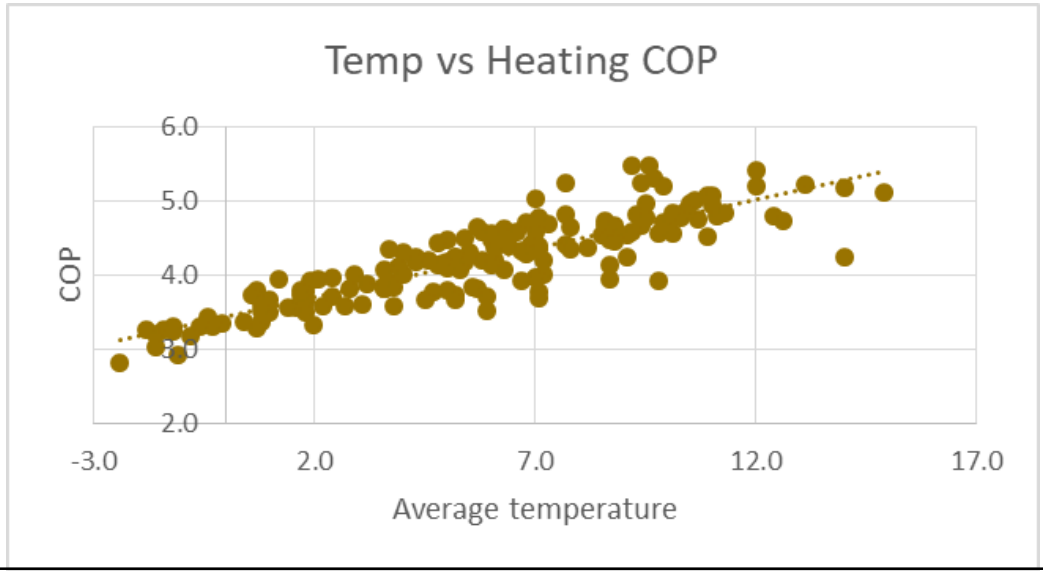
Control and monitoring

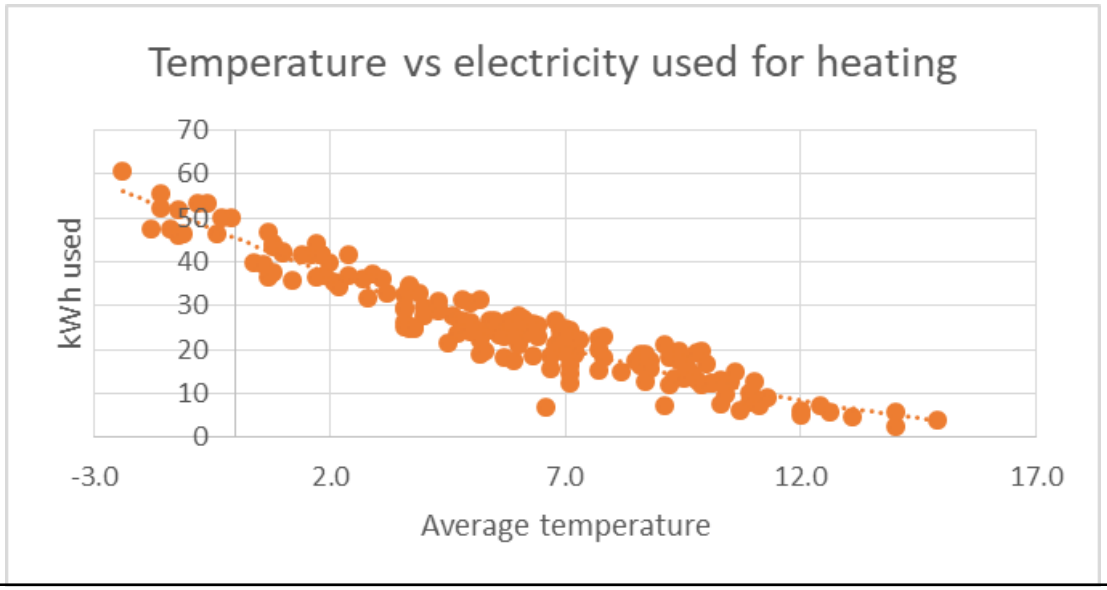
- Battery can be set to fill at night, cheap off peak energy in winter
- EV can also recharge at night cheaply in winter
- Room temperatures can be set (4 times per day)
  - Keep to within 3 degrees over 24 hours – much more uniform temperature
- I have collected daily data plus outside temperatures
- My house uses 8 kWh daily when no heating is on
  - Hot water, fridge, freezer, appliances, hob, oven, microwave, etc

The colder it is, the more heating is needed



The colder it is, the less efficient the ASHP is

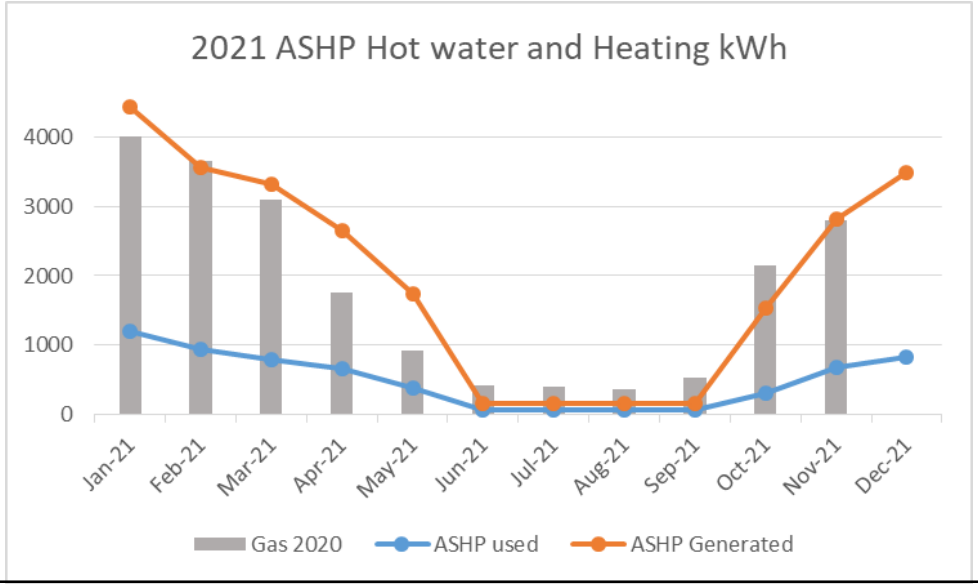




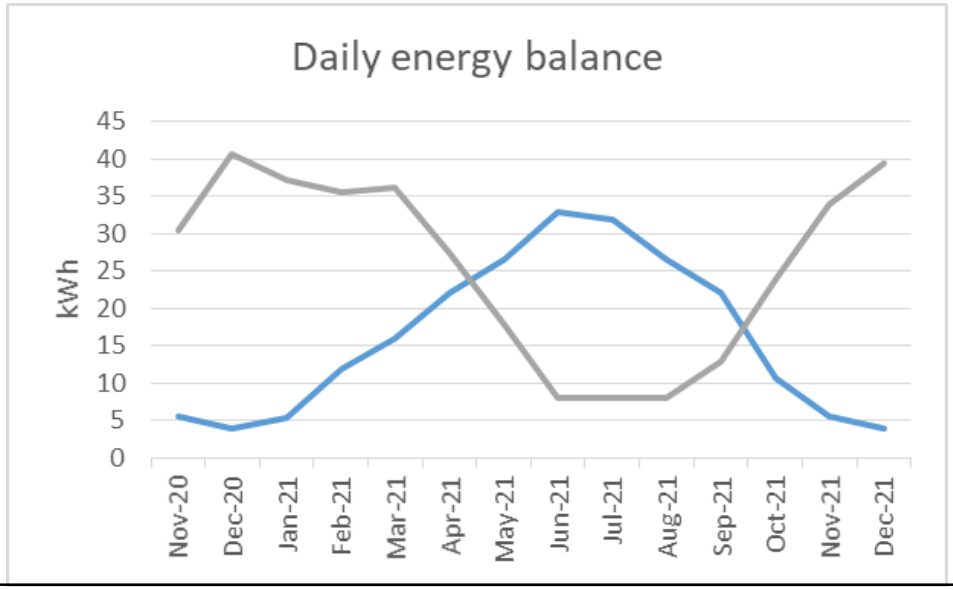
Winter

- The ASHP works even in very cold conditions
- It has a reverse flow system to defrost itself

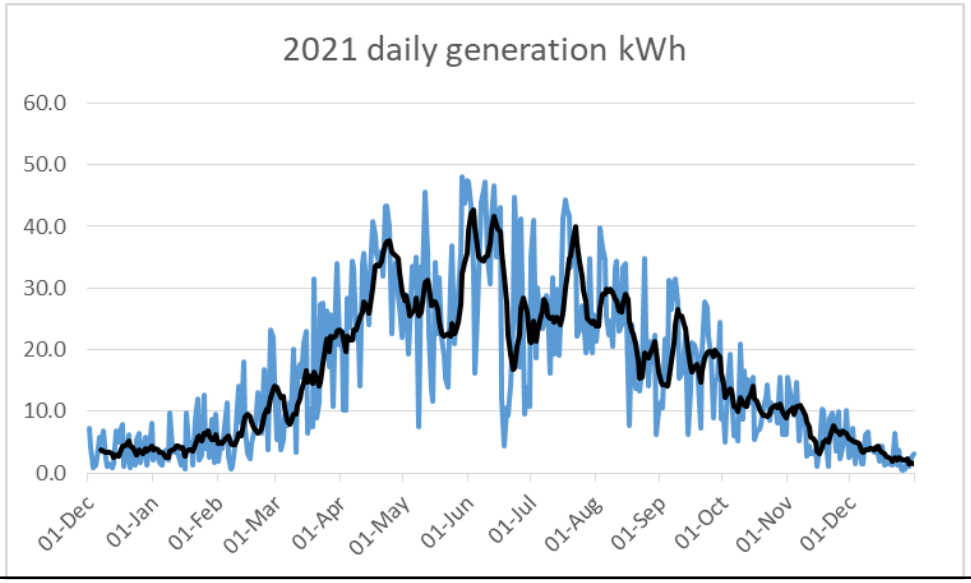
Electricity used/consumed: Hot water + Heating



Daily electricity demand, including ASHP, vs generation



Solar generation fluctuates!



Tariffs - I'm on Octopus

- Winter:
  - Import: Octopus Go – cheap at night for 4 hours 7.5p/kWh (as I have an EV)
  - Export: fixed 4.1p/kWh – very little exported as I use what I produce
- Summer:
  - From June to Sept, I am on Octopus Agile for export (higher prices)
  - With car, hot water and house all on Solar (heating off) using battery storage

Prices 2022/23 - wholesale

https://www.cliffordtalbot.co.uk/energy-prices/

Electricity is 3 times gas cost

Economics

- Electricity is usually 3 x more than gas
- But the ASHP produces 4 x more energy than it uses, on average
- Invested £15,400 in solar and batteries
- ASHP £14,600 less subsidy via RHI £11,400 = £3,200 (new boiler needed anyway)

Economics

- Octopus prices from July 2023 (excluding standing charges):
- https://octopus.energy/blog/energy-price-cap-july-2023/
- Electricity: 30.72 p/kWh
- Gas: 7.4p/kWh
- 4:1 so manipulation of energy costs with battery helpful (at a cost)
- Using 2020 data:
- Gas alone would have been costing 21,500 kWh x 7.4p = £1591 p.a.
- Plus electricity 2000 kWh x 30.72p = £614 p.a. **Total £2205 p.a.**

Economics for 2023 (excludes Government subsidies)

- Import 1800 kWh at high price (38p/kWh) = £684
- Import 3200 kWh at low price (7.5p/kWh) = £240
- Weighted average = 18.5p/kWh
- Solar generation = 6970 kWh

  45% consumed = 3150 kWh @ 38p value = £1200

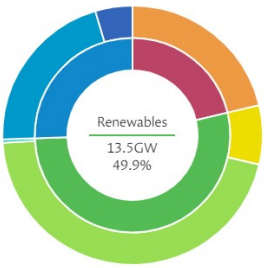
  55% excess sold = 3820 kWh @ 10p value = £ 382

Net outgoing cost (£684+£240 -£382) = **£542**

Saving £1663 p.a. So payback about 9 years.

Carbon

National Grid live
https://grid.iamkate.com/



- National electricity supply that is being generated in UK is being 'decarbonised'
  - Less coal, more wind and solar, etc
- UK imports some gas so is vulnerable to price changes
- The carbon emissions I have saved per year = 1 return trip to Australia
- Some people have concerns about embodied carbon and recycling issues with solar panels and batteries.

Summary

- I have changed my energy use away from gas to electricity
- I use my electric car as much as possible
- I have reduced my carbon footprint
- By:
- Fitting solar panels and batteries
- Utilising off peak electricity
- Controlling energy costs (switching tariffs)
- I have reduced the impacts of increasing energy prices
- After 9 years I will have achieved payback.

Thank you for listening

- Hope you make the change
- Website https://martleshamclimateaction.onesuffolk.net/