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

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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.

![Graph showing generation Year 1 (2019/20) for East gen with actual vs expected kWh.]

East panels Year 2  3670 kWh Actual vs 3975 est

![Graph showing generation 2021 for East panels with actual vs expected kWh.]

16/07/2023
East gen Year 3  4300 kWh actual vs 3975 est

**East Generation 2022**

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 generation 2021

West gen Year 2 - 2666 kWh actual vs 2585 est

West Generation 2022
Totals

Total year generation vs estimate kWh

Total kWh 2021

Actual 6125 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 170m²
- 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°C day, 17°C 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

![Graph showing electricity consumption]
Daily electricity demand, including ASHP, vs generation

Solar generation fluctuates!

2021 daily generation kWh
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/](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 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/