
*Figure 1: Arotherm plus 5kW outside unit*

In October 2025 we had our gas central heating system replaced with a Vaillant Arotherm plus 5kW system.
Much as I would have liked to install a level 3 HeatPumpMonitor
the the additional cost, the lack of space and the unwillingness of the installer meant it was not feasible at the time.
However having a magic box in the garden consuming my electricity and not having a clue what it was up to irked me, so I decided to create a simple DIY monitor.
This is all belt and braces - nothing sophisticated mainly using stuff I already had lying around together with some Linux shell scripts.
This is not a howto guide as I am sure there are many better ways of doing it and I am sure many people have done similar things so probably nothing new.

Components:
emonpi: An old unused raspberry pi 3b+ running emoncsm based on the free emonsd download.
2x DS18B20 flow/return temperature sensors attached to an esp32 wifi controller.
Shelly EM energy monitor attached to dedicated Heatpump meter tails (+120A clamp). Data read using the Shelly API.
Indoor/outdoor temperature via existing Watson W-8681 MK2 - Wireless weather station. Data via open source weewx weather station software also running on raspberry pi.

Flow rates: My heating is a hydraulically separated system with a 4 port buffer tank. Flow rates according to the white VWZ-AI control, appear to show a constant flow rate of 860litres/hour (14.33litres/min).
This also seems to be the case for many of the Arotherm+ units on HeatPumpMonitor.org. This may not be the case for other models of heat pump or other systems. There is no DHW status sensor. The emonpi aims to monitor total heat out and electrical energy in.
The temperature sensors are attached using copper strips and  heat transfer compound to the primary hydraulic circuit entering and leaving the buffer tank, and covered in pipe insulation. There is video from John Cantor on this, as well as the docs section of openenergymonitor/emontx4 on github.
The two DS18B20's show the same temperatures +/- 0.2C under identical conditions which means that the temperature difference between flow and return should be reasonably accurate. A constant offset could be added to one of these to increase accuracy if needed, but this was not empoyed here.

The main cost of this system was £80 for the Shelly EM with a 120A CT clamp. The temperature sensors and esp32 were an addiitonal £10.
The data from the sensors is fed to the emonpi via a simple script employing the linux curl command based on the examples given when logged into emonpi and then


*Figure 2: emonpi : Only a power connection required*

displayed via the MyHeatPumpMonitor App on the emonpi.
The Shelly, the weather station and the esp32 controller all have their own IP addresses and are accessible via the wifi network and hence the emonpi does not need any physical connection with the sensor components and can be placed anywhere in range of the router.
There is no electrical or hydraulic connection to the heating system, so no modifications of any kind are required.


*Figure 3: Shelly EM mounted in small junction box*

*Figure 4: Shelly 120A CT clamp on ASHP tail*

The Shelly is powered by a 13A plug from a standard electrical socket and the CT clamp requires no connection to the electrical supply.

An alternative to the Weather station would be another esp32 and another pair of DS18B20 sensors for inside/outside temperatures.There is no DHW status sensor.

The emonpi aims to monitor total heat out and electrical energy in.


*Figure 5: DS18B20 flow/return sensors before attachment.*


*Figure 6: DS18B20 attached to return pipe*

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What's the point ? I think the main advantages are:
1. Checking on cycling activity.
2. Checking on defrost activity.
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3. Full live electrical energy usage including all pumps, controls, and immersion heater if used.
4. Check quickly how the system reacts to changes in the basic settings.
5. Detect unusual behaviour - eg faults.
6. Provides an independent assessment of system performance in different weather conditions.

Does it work ?
Yes it seems to give reasonable results that address points 1-6 above.

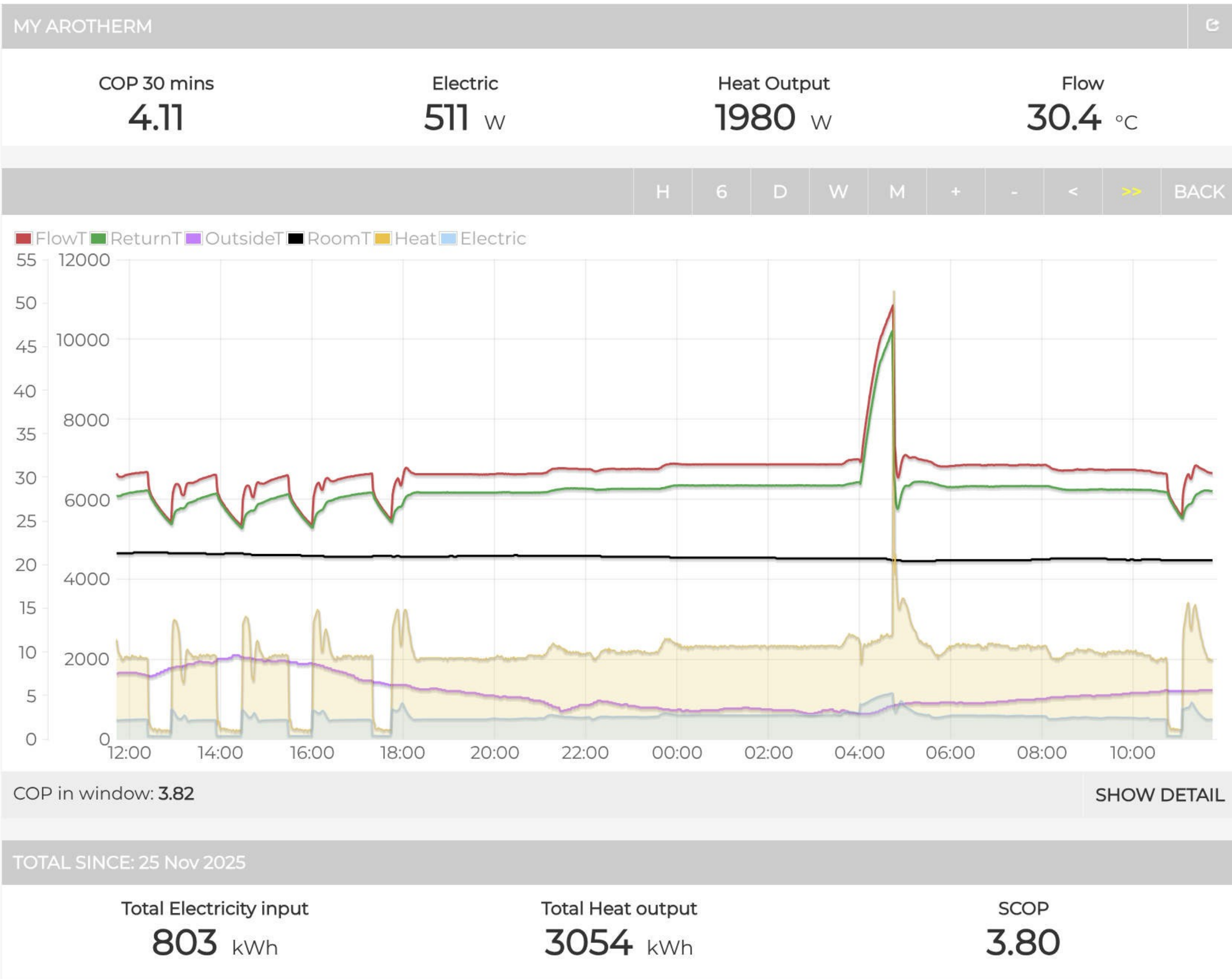


*Figure 7: Various activities. Cycling, steady and DHW cycle 29 Jan 2026*

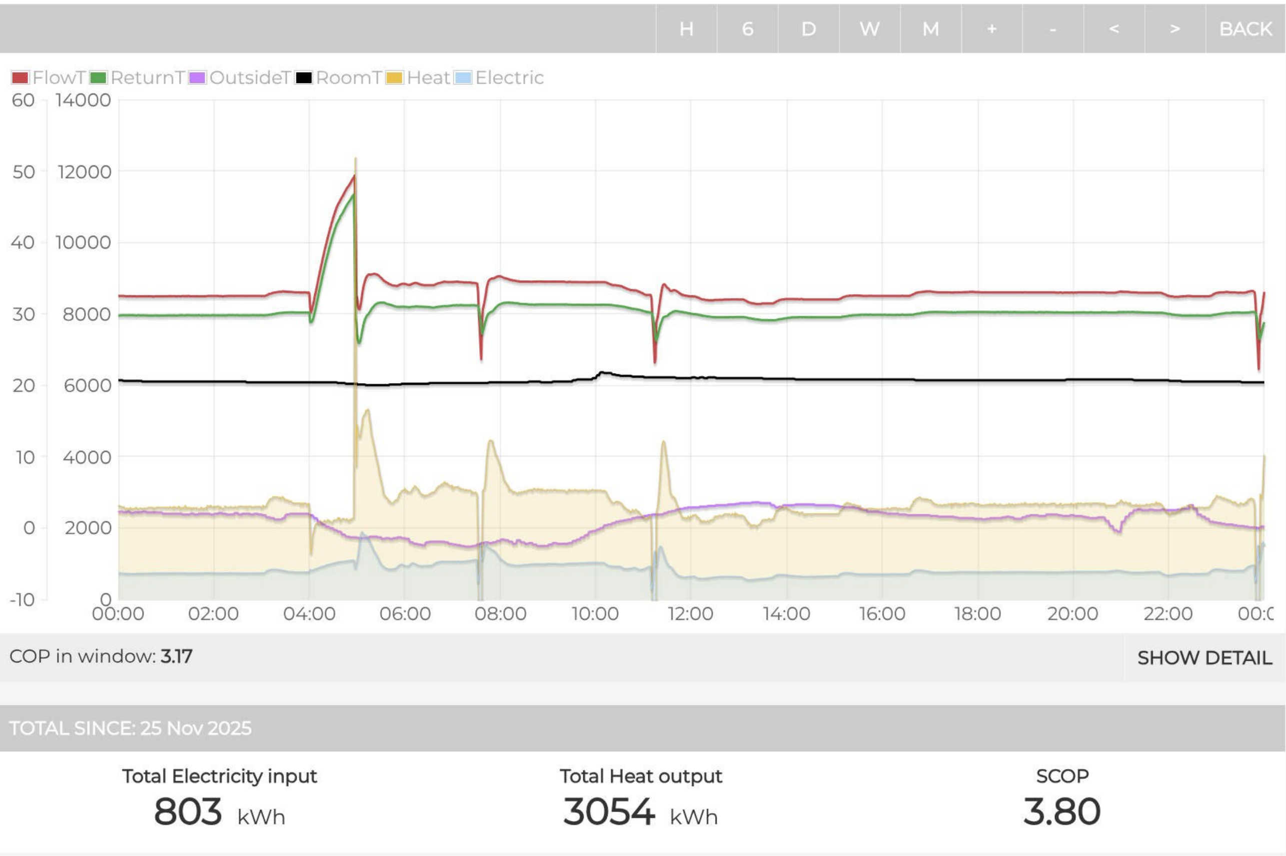


*Figure 8: Defrosting activity as the temperature fell below 0C on 05 Jan 2026*

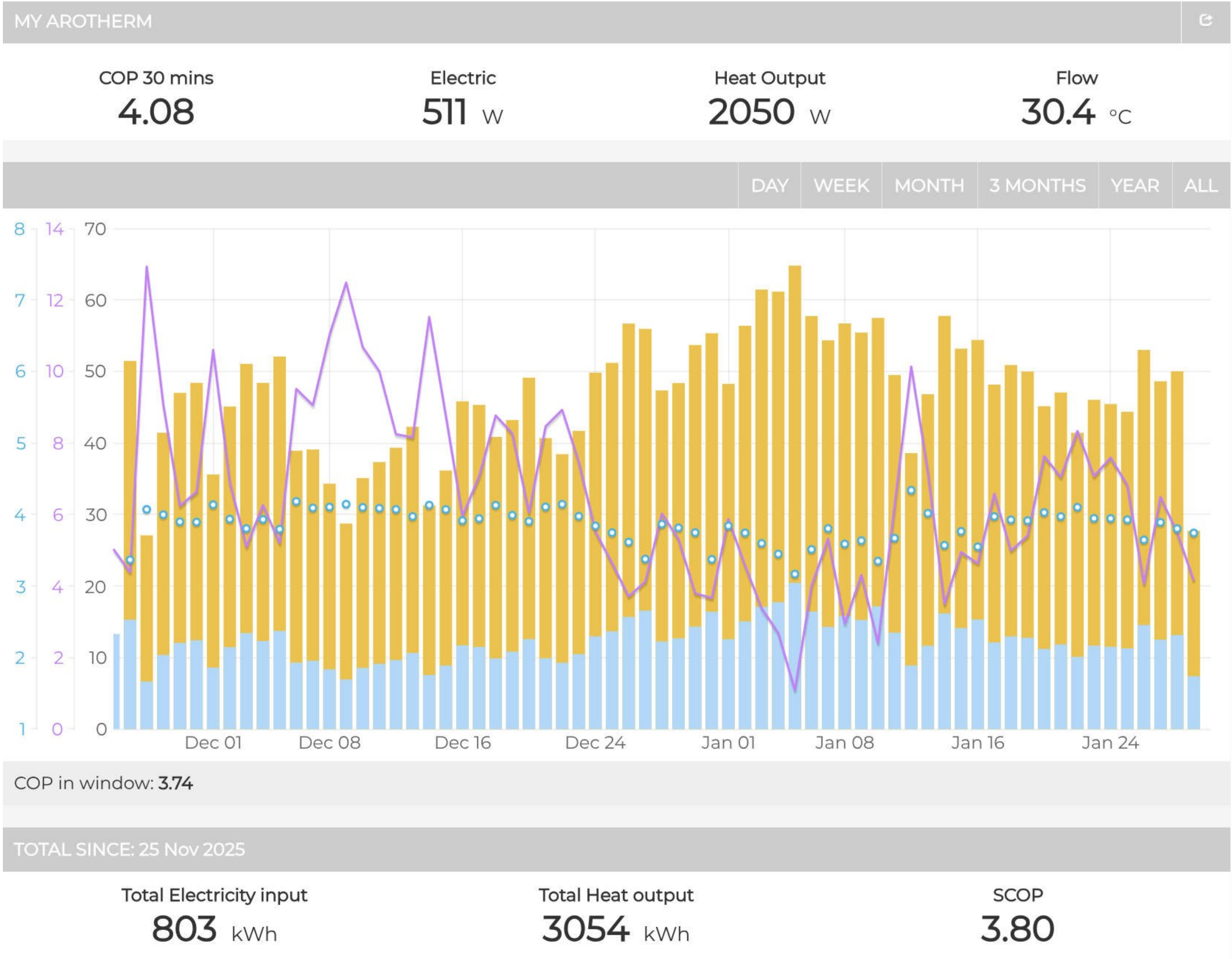


*Figure 9: Performance history.*

COP estimates and conclusion.
The emonpi provides an independent answer separate from Vaillant's own figures.
I now have 3 different estimates of COP.

1. As given by the MyVaillant App (does not include extra pump and controls).
2. Calculated from the heat output using myVaillant combined with the total electicity input measured by the Shelly monitor. (MyVaillant heat)/(Shelly Electrical Energy)
3. As calculated by MyHeatPumpMonitor app on the emonpi.
   Heat power= DT*Sw*F = Temperature difference [C] X Specific heat of Water [kJ/kg/C] X Flow rate [litres/sec]
   Electrical power as given by the Shelly API.

Average COP

| | 1.MyVaillant | 2.MyVaillant+Shelly | 3.DIY HeatPumpMonitor |
|---|---|---|---|
| Dec 2025 | 4.31 | 3.82 | 3.89 |
| Jan 2026 | 4.16 | 3.69 | 3.71 |

As expected MyVaillant gives the most optimistic values as it is only measuring the performance of the outside unit.
Estimates 2,3 are very close which I did not expect.
The accuracy of flow/return temperatures and actual flow rates are never going to match that from a level 3 HeatPumpMonitor.
However a DIY monitor does show what the system is doing minute by minute which I find very useful and reassuring.
It allows a subjective comparison between my system and other similar systems on HeatPumpMonitor.org as regards onset of cycling and defrosting in similar weather conditions. Changes in settings can be quickly assesed.
Any malfunction or unusual behaviour can be picked up quickly.

Nick B. January 2026.