STBA and the PassivSystems: SMETER Project

PassivSystems is one the UK's leading software companies who specialise in energy systems. Its mission is to 'create sustainable value through the use of smart technology within the residential energy supply market.' Combining this aim with the expertise of the STBA has proven a recipe for success.

The initial concept to put the two organisations together came from a spark of inspiration by our now Director, Peter Draper, at a South Wales meeting of the Wales and West's Freedom Project (see https://www.westernpower.co.uk/downloads/12221). It was in the nick of time as the STBA was able to approach PassivSystems to alter their bid for the BEIS SMETER competition. The basic idea was to expand pure energy monitoring (the SMETER concept) and increase its scope to take in the Whole House Approach. For this it would mean measuring IAQ and moisture as well as internal temperature.

PassivSystems developed the monitor technology so that it was able to work on the Sigfox network – part of the emerging Internet of Things (IoT). The monitors would generate readings for Temp, RH and CO2 every 20 minutes and communicate this using very small data packages to the network. This meant that a small unit (think of the size of a smoke detector) could be powered for around 2 years from its onboard battery pack.

The units were installed, after checking that there was a strong enough local Sigfox signal, attached to a wall (using non-marking stickers), switched on, the data flow was confirmed with PassivSystems by a quick phone call and left in situ with a willing client.

Of course, not all things run as you would like, especially with new systems. We had some major issues with signal strength in the upper valleys region of Torfaen, so we were forced to change tack and the units were installed into 12 traditionally built homes in Cardiff. These homes were not due to be retrofitted, so we wouldn't get the data on 'before and after', however we could still trial the issues around customer engagement, installation, positioning, data flow, analysis and reporting.

The main findings from these elements have been:

People are keen and willing to help out when they understand the purpose and intention that lies behind the project. This takes time to sit down and explain and requires the right approach. It was helped by the fact that the units are small, unobtrusive, and won't leave a mark when removed.

Installation needs to focus on the actual ability of the unit to connect to the network. So an initial check on arrival at the property is required to help ensure that the final positioning will be viable, otherwise it can be an hour of engagement that leads to no install and disappointment for all.

Positioning is really important. The units themselves have certain requirements like being away from physical factors like heat sources, vents and opening. They also needed to be away from direct sunlight and where there was enough air-flow. Ideally they would also be around 1.5 meters off of the floor etc. Then there are the social considerations. Despite the small size etc people don't want to have a square white monitor in a prominent position, nor did we feel that it was appropriate for bedrooms (although we asked and did indeed place a couple of 'second property' monitors upstairs – this allowed us to compare first floor and ground floor results) and of course you cannot install in bathrooms and kitchens where readings would be widely skewed by activity. The most common 'acceptable' locations tended to be in central hallway or in a lounge.

Data flow was largely dependent on the signal strength. In one house we ended up having to place the monitor upstairs as there was not an adequate signal downstairs. We also found that where there was a weak signal the data flow was intermittent and so this affected the quality of the results. We also had issues with data flow from the weather station that we used. Local weather watchers supply data to Met Office WOW website and we used these to give us background temperature and RH data, however this did 'go down' for two weeks and we had to backfill with Cardiff Uni weather data.

Analysis has been manual. Even with 'just' 17 data feeds from 12 homes the time required to analyse three variables generated every 20 minutes over 18 months is immense, let alone comparing this to selected weather data produced every 10 minutes. Thankfully, some assistance from the Building Performance Network came to our aid. The issue, though, was what does all this mean? We had to impose some rules. These rules from the STBA and partners have been based around a traffic light system. We really only need to know what's going wrong and to highlight these instances. So we set out to develop a series of conditions that allowed us to report when: it was too cold, too warm, to humid, too dry (in Wales!) or that the IAQ was poor. The rules were based on the building regulations, best practice and emerging standards based around ventilation. Put all this into the mix and each file from every monitor amounts to 40Mb! So, we are working with around 0.7Gb of data altogether. This way of working is of course not viable, so the clever people at PassivSystems are embedding the 'rules' into the data at source.

Reporting is thankfully becoming automated by this coding at the data collection end. The results are encouraging and we are currently in the position of refining the algorithms so that this mass of data is refined down to one figure: A Whole Home Health Score based on comparative internal temperature and RH data and IAQ factor based on CO2. Whilst some of the results still require looking at the raw data files the process of refining 20 min data to daily data to an overall score should prove useful in the market. The Whole Home Score only indicates the overall health of the home but it does this by using standardised rules, thus allowing for comparisons to be drawn between homes. If this score flags up any issues the system provides a series of graphics, based on the daily data, that show how the interaction between the building and its' occupants was performing in each of the three metrics. An example is shown below in Figure 1.

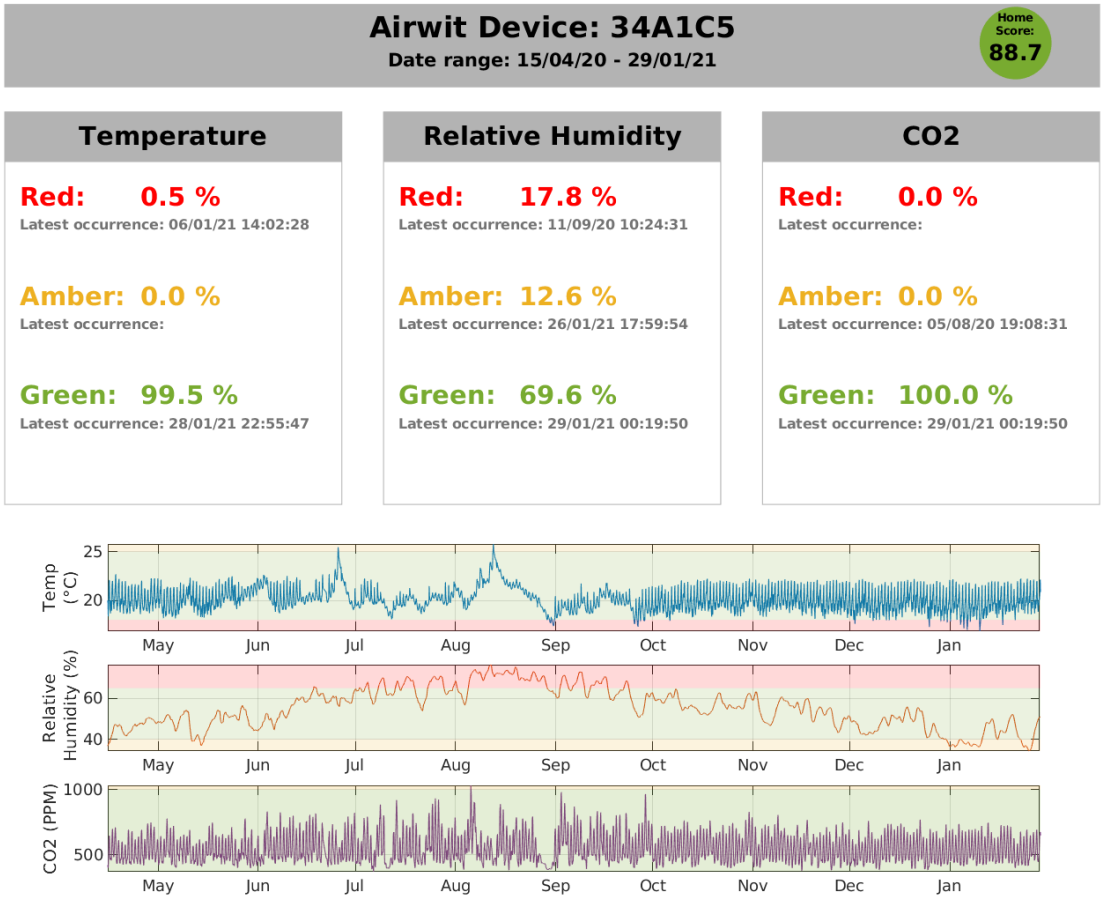
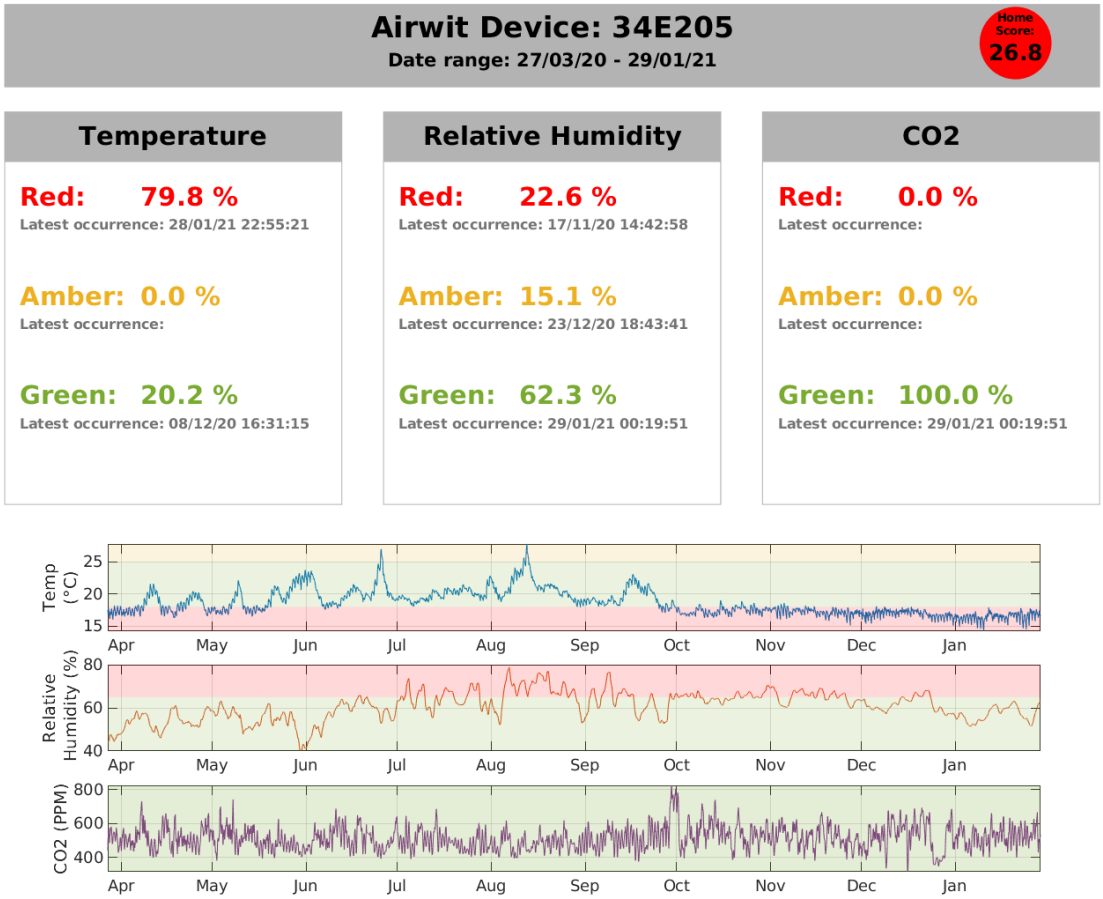


Figure 1 A very good Whole Home Score report

Figure 1 illustrates a well performing home with steady internal temperatures, low CO2 and good RH. However, even here it shows one of the remaining issues for the project: comparable RH. The higher RH in the summer is purely linked to external conditions and is not a function of the house or its occupants (bar opening windows to ventilate their home).

In Figure 2, we can see another of the issues that we need to resolve using the algorithms. What to do when people choose to run their heating at around 17 - 18 degrees. The cut off point for 'acceptable' internal temperature is 18 degrees, so this household is constantly dipping in and out of the 'red' zone. Is this a problem? If the system were too automated then maybe, but it is obviously not a problem for the occupants. The RH is still dominated by summer external conditions and there appears to be little issue in the winter with figures just topping 65% RH.



In conclusion, there is still a little refining to do, but we see that this simple tool can be a useful addition for owners in all markets: the RSLs, Private Landlords and interested Owner Occupiers. A simple summary metric gives an overall indication of performance and the detailed graphics does allow for interpretation to help solve issues around condensation, IAQ and over /under heating. The STBA and PassivSystems will be working on the final push to create this system to be market ready over the coming months.

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[1] On 21 April 2021 the business of PassivSystems was acquired by BUUK Infrastructure and is now trading as Passiv UK. All staff, systems, IP and infrastructure have been retained by the new company and the team looks forward to working with the STBA to conclude its work together.