Tomintoul Development Energy Investigative Work

Phase 1 findings – site visit

Introduction

Locogen were asked by Tomintoul and Glenlivet Development Trust (TGDT) to review the installation of the renewable energy infrastructure that had been installed on 12 community houses in Tomintoul. To facilitate this, David Linsley-Hood attended site on 12th and 13th Feb 2024, supported by representatives from the Community Housing Trust (CHT) to access and review the installations at five of the 12 properties (three tenanted and two sold properties).

The project stems from a series of questions related to the ability of the systems installed at each property to effectively interact with each other to provide low carbon heat and electricity. Questions had also been raised by residents around the quality of the installations, so the site visit enabled a review of the general quality of the installations as well.

System overview

Each property visited has the same basic infrastructure installed. This comprises of:

- **Samsung ASHP** (two different capacity units depending on size of property). This provides Space Heating and DHW primary supply for each of the properties. The wet distribution system is through radiators. A single thermostat/timeclock is located in the central hall/lounge of each property, with a further controller located in the utility space with the Sunamp and heat pump control system.
- **Sunamp** DHW phase change thermal storage vessel, charged through the ASHP as primary system, and an electric resistance heater as a backup unit. The Sunamp does not have a timer control, but operates on a demand signal, either acting as the priority load when the heating cycle is enabled, or if the unit falls below a preset level of capacity then the Sunamp will call for heat. This will enable the heat pump as a primary source, but if the unit has not been satisfied within 45mins, the backup electric resistance heater will be enabled.
- **Solar PV** installed on the roof of each property. The size of each array varies depending on the property but are all installed using similar mounting systems, inverter and module arrangements. The PV inverter is connected to the distribution board in each property, supplying electricity to any loads concurrent with generation, and any excess being exported. Both a generation and import/export kWh meter were present.
- **Zappi EV** car charger installed on the outside of each property.
- **EDDI solar diverter** located in the distribution board area of the property. This has the capability to divert electricity to specific loads (such as water heaters), or trigger loads to enable (such as the Zappi EV charger) when there is excess solar generation and this would otherwise be exported to the grid.

Site visit findings

Solar PV

Visual inspections of all of the solar PV systems indicated that they appeared to have been installed to a good standard and showed no obvious signs of degradation. In four of the five houses visited, the PV systems seemed to be operating, but I could not investigate the inverters or modules due to access limitations (the inverters are in the loft spaces). The location of the inverters is common these days for new-build properties, but does mean that visual inspection of the inverters to identify operational faults is more difficult. The Solis inverters selected are

passively cooled, so it is important for the units to kept clear and allow air to circulate, so residents should be advised not to store items directly around the inverters.

At 48a Main Street, the system has a very low generation value (3.5kWh – compared to ~1,200kWh for comparably sized and orientated systems at the site). The resident stated that the unit may have been off for a period, but unless it had only just been switched on in the couple of days before I arrived this would indicate a system fault. This should be investigated further as it is probably not functioning effectively, however I am unable to state at this stage whether it is an inverter fault or a stringing issue in the modules. All other systems had readings on the generation meters comparable to the estimated yields for systems of the assumed size at each property, however a detailed comparative calculation has not been undertaken as the length of operation and exact system configuration are not known. Outwith the one system identified, none of the others seem disproportionately high or low.

None of the residents had set up any arrangements for obtaining the SEG export tariff, meaning that they are currently not receiving any value for the exported electricity. Discussions with several of the tenants indicated that they were aware but had not progressed the process. They also indicated that they had only recently received MCS certification documents, which would enable them to apply to many of the SEG providers. Support and guidance on the process for doing this would enable the residents to claim back any exported electricity value – information is currently available online through OFGEM - https://www.ofgem.gov.uk/publications/smart-export-guarantee-guidance-generators and this also directs individuals to the SEG providers which can provide their specific application requirements. Organisations such as SCARF may be able to provide additional practical support.

Air Source Heat Pump units

In four of the five houses visited, the heat pump installations seemed to be working fine and a visual inspection indicated the ASHP unit and ancillary plant had been installed to a good standard. Each of the properties were warm upon entry and none of the tenants said they had issues maintaining temperature while the systems were operating, although three residents referred to issues where the heating had been down for period of time and they had relied on backup heat sources (electric plug in heaters).

The units are able to be controlled via the wall room stat/controller to set temperature and time. There was a general level of confusion about the controls (which did what, that the time control was for target time to heat, not time to turn on, etc), and the optimisation use for a heat pump system in general in terms of longer, low-level operation. The optimised settings will be reviewed and this information compiled as part of the Phase 3 training.

At 4 Cults Drive, the heat pump has a fault and tripped out on several occasions during the visit, and it had been operating in this state for some time. A number of remedial repairs, including swapping the RCBO for MCB and the installation of an additional 63A RCD unit have already been tested. Following some investigation work with the Samsung engineer on the phone, it would appear that there is an earth leakage fault somewhere at the property which is causing the unit to trip out. This needs to be investigated and remedied as a matter of urgency.

Additionally, 4 Cults Drive was the one unit where the DHW cycle temperature was not reaching the required flow temperature to initiate the Sunamp phase change (during my visit the DHW cycle did not exceed 60°C). In discussions with Sunamp they indicated that this could be because the air temperature was low (around 0°C air temperature at the time of test) and the heat pump was not capable of reaching these target temperatures. However other units were capable of meeting these DHW flow temperatures under similar conditions, so this should be reviewed further.

I believe these are two separate faults at 4 Cults Drive and should be dealt with sequentially.

A question was raised by one of the residents regarding the need for insulation on the internal pipework. Having reviewed the guidance for domestic heat pump installations there is no clear instruction to provide this within heated spaces. The need for insulation within unheated areas or outdoors is clear, and external insulation is present between the outdoor unit and the building. However opinions differ on the need for insulation on internal heated pipework as typically any heat loss from these pipes is seen as a passive gain to the building heat. Insulation was present on the cold water pipework to prevent condensation.

Sunamp

The Sunamp units at each property were able to deliver hot water under test, but one resident (6 Cults Drive) reported that the capacity of the system seemed low and that it was not providing their expected level of hot water provision. Having discussed this subsequently with Sunamp, the only option to test this would be a drawdown test to confirm whether the system is operating within expected capacity parameters, and if any warranty claim could be made.

The current setup does not provide timed hot water recharge on any of the systems tested. Instead the hot water system charges from the heat pump whenever the heating system comes into operation, if the unit is below a full state of charge. If it drops below a preset level, it will trigger a demand in the heat pump to initiate a recharge cycle. If this has not satisfied the Sunamp in 45 minutes then the electric immersion heater is triggered.

All of the electricity for both the heat pump and the backup electrical resistance heater is taken directly from the distribution board (not via the diverter). This means that if there is any solar electricity being generated at the time of operation, then this will supplement the demand for these circuits, but there is no prioritisation that enables the DHW charging at times of export.

This issue was discussed with Sunamp at length, and given the setup installed (and specifically the equipment available at the time of design) it was confirmed that it is not possible to have a Sunamp unit that could be fed by both the heat pump and the diverted excess solar PV generation. For clarity, at the time this system was designed and equipment selected, Sunamp only supplied units that either operated on direct electric with solar diversion, or systems fed by heat pumps, with electric backup. Only in more recent times have they launched a specific unit that is capable of working with both a heat pump and solar PV diversion, and this was enabled by specific manufacturers developing heat pumps that could guarantee higher output temperatures that would meet the flow requriements under all UK conditions. Sunamp state that the systems installed at Tomintoul cannot be converted or retrofitted to operate in a hybrid heat pump/solar diverter mode at these sites. This is for key reasons:

- The Sunamp needs to guarantee that the backup heater can operate on demand. If it is wired to the solar diverter then it will only operate when the PV is in export. This is of importance during excessively cold winter periods where the ASHP unit cannot guarantee to provide flow temperatures sufficient to not need to call on the direct electric backup.
- If the electric element was wired to the Eddi, it would operate whenever the diverter selected it. However, as the Sunamp is set to run in an on-demand mode it cannot always guarantee that there will be capacity for the energy to be used effectively. In the hybrid models Sunamp have developed more recently, the unit now operates on a timed setting and does not heat fully using the heat pump (reducing the effective volume) to maintain a permanent headroom for the diverter to heat.

Eddi

An Eddi unit uses current sensors clipped to the primary power cabling in each property to sense whether the property is importing or exporting energy, and if in a state of export, trigger demands within the property to switch on (either directly wired through the unit as a primary/secondary load or triggered wirelessly). There is one unit installed at each property. These are connected wirelessly to the Zappi car charger. Only one of the properties has an EV

(and this was already charged at the time of my visit) so I was not able to test the functionality of the Eddi diverter in any of the properties.

None of the properties have a physical wired connection between the Eddi and the Sunamp unit, for the reasons outlined in the Sunamp section, so none of the installations are capable of diverting solar PV directly to the Sunamp unit in times of excess generation. However it should be noted that any excess PV energy generated while the heat pump or Sunamp are operational will still be used locally to feed these loads (as well as any other site demands) before any export takes place. It is just that the Eddi unit will not actively call on these demands to switch on to absorb the generation.

Additionally, during the survey it was noted that one of the properties had a second CT sensor available in a box that could have been fitted on the PV generation supply, but has not been installed. It means that the Eddi unit cannot show the generation compared to the import/export values. I was informed by the resident that all properties have an extra unfitted sensor. However the cables where the second sensor would need to be located are installed behind the wall in each property, making a retrofit of this sensor challenging.

Ancillary notes

There were a number of ancillary issues or concerns raised, mainly relating to the system repair and lack of clarity around fault and repair times. I appreciate this is likely because the engineers attending site are unclear on the issues themselves.

Additionally in the two Cults Drive properties the concerns around electrical safety were raised and the lack of test certificates.

Phase 2 findings – Discussion

One of the key clarifications required in this work related to the question of how the solar PV feeds the other systems within the properties. When the outline specification was proposed, the intention was for all these systems to support each other to trigger the optimum use of generated energy onsite.

To an extent this has been achieved - If an EV vehicle is connected and the solar PV is exporting, it will trigger the EV charger to charge, if it is not already. In other respects, the installation is just as any other domestic system where the PV inverter is connected to the domestic distribution board – if the PV system is generating, then this will supply local demands first before drawing additional energy from the grid. In this way the PV systems at each property are supplying some PV energy to those systems, and the heating and Domestic Hot Water supplied from the heat pump and electric resistance heater will benefit from that (although at this time it is not possible to state to what extent).

What is the case is that the system is not able to automatically trigger the charging of the DHW system when excess solar energy is available, for the reasons outlined previously.

With regards to the points raised by householders with regards to energy bills, unfortunately due to issues with the electricity meters an analysis of the properties consumed energy vs predictions was not possible. It should be noted that the value of electricity has doubled in the time since the initial concept designs for the project were developed, an unprecedented rise which will have had a corresponding impact on resident bills.

Phase 2 findings – Remediation and next steps

From Phase 1, we have identified a number of issues and faults that should be remedied. For ease, I have split these into repair issues and training issues:

Repair issues

- 48a Main Street PV installation should be inspected and tested to ascertain why the generation performance is so low. Any investigation should involve a test of the electrical system (AC and DC) and inverter operation to confirm whether this is an installation issue or whether it had been incorrectly isolated.
- 4 Cults Drive electrical system should be investigated for a potential earth leakage fault.
- Once this has been remedied, 4 Cults Drive Heat pump unit should be operationally tested to ensure it is meeting the required DHW flow temperatures necessary for Sunamp operation.
- A drawdown test should be undertaken on the Sunamp unit at 6 Cults drive to ascertain if it is able to meet the required operational capacity.
- The current Eddi system is only capable of showing what is being exported, not the balance of solar energy being used in the property. This would require the second CT to be installed. The cabling necessary for this is installed in the wall and would require significant work to enable the installation. Whether this is necessary would depend on the value that could be gleaned from the additional information. However, the system was supplied with the additional sensors and should have been fitted, so should be on the defect list.

Training issues

Overall there was some knowledge of the mechanics of the system components, but also a number of misconceptions that need to be addressed. These will be covered in the training sessions to be delivered as Phase 3. However specific reference will be given to:

- Application process for the SEG
- Clarification on controls