FLATLINE - FIXED LEVEL AFFORDABLE TARIFFS LED BY INTELLIGENTLY NETWORKED ENERGY

EXECUTIVE SUMMARY – PHASE 2

Following the successful demonstration of its feasibility within the Phase 1 report, the FLATLINE project progressed to Phase 2 which was tasked with providing a scalable real word example of active energy demand balancing through domestic Demand Side Response (dDSR). The 18 month project led by collaborators Sero and PassivSystems supported by Pobl Living, Tirion Homes and Western Power was also supported by the Department for Business, Energy and Industrial Strategy (BEIS) as a result of their "Domestic Demand Side Response" competition.

FLATLINE's concept is based on typical domestic energy consumers benefitting from low, fixed price heat and power bills whilst also providing dDSR services to lessen the impact of those homes on the National Grid. Put simply, FLATLINE proposes a win:win:win scenario.

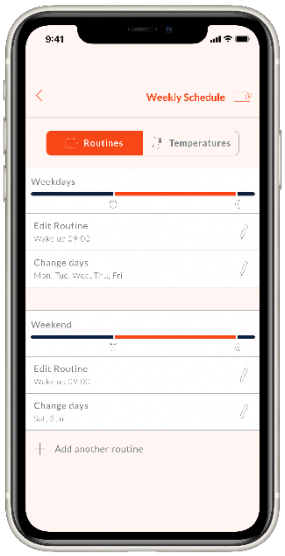
WIN Significantly lower bills for occupants practically eliminating the risk of fuel poverty

WIN Shift electrical demands on the National Grid entirely 'off peak

WIN Develop a new UK business model that is internationally replicable

The project trialled its methodology on two newbuild pilot sites: 56 homes at Parc Eirin in Tonyrefail (all 225 homes within the development will be fitted with the FLATLINE technology) and 3 homes at The Mill in Cardiff. These homes were built to a higher specification than industry average ensuring maximum thermal envelope efficiency. Through careful monitoring of the build from the foundations up, we ensured there were no significant deviations in what was designed and what was implemented on site. This misalignment of design and delivery is commonly called the "Performance Gap", and in the UK it is estimated that the gap between design and construction is around 27%. In addition, these homes were installed with;

- Solar panels for energy generation
- Battery for energy storage
- Smart hot water tanks
- Ground source heat pumps
- EV chargers
- Building Energy Engines (BEEs) – the background energy management systems developed by Sero and PassivSystems



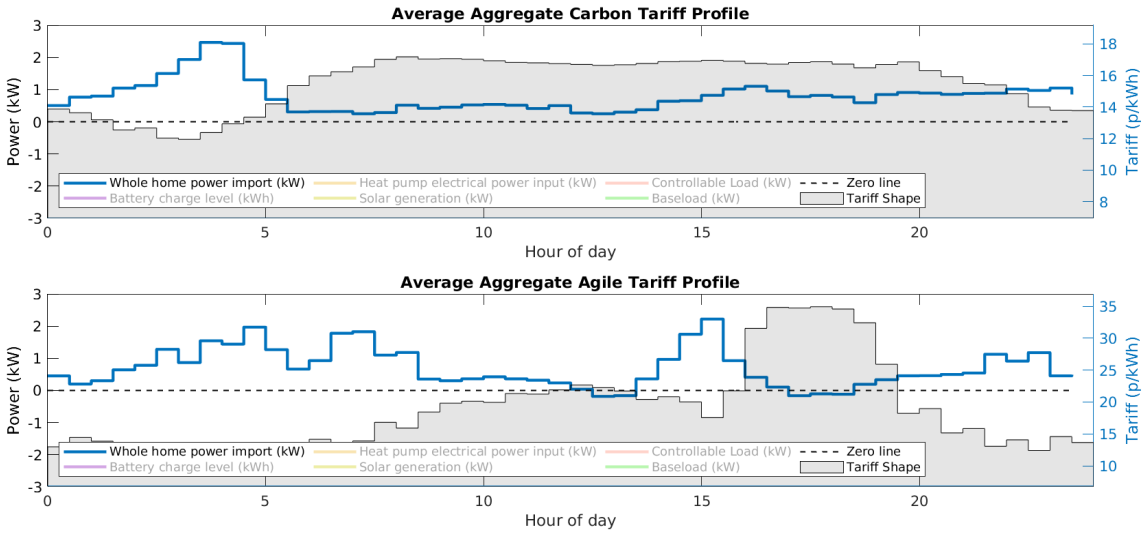
Resident comfort was deemed the ultimate priority, as no business model would be successful should its customers not be satisfied with the service. As part of the new build handover process, residents were offered to be onboarded onto the Sero Life energy management platform. Residents were asked to provide an insight into their weekly routines so that bespoke heating schedules could be formulated for each home to meet their individual needs. This included such factors as;

- what time they wake up
- what time they leave for work
- what time they return from work
- what time they go to bed

Each of these events was then set to their desired temperatures, whilst the BEE intelligently drew, discharged and anticipated energy demands. Should the residents wish to change their set temperatures or schedules, they can do so by the click of a button through the Sero Life App. Residents are not contractually bound to Sero Life and are free to switch to another energy provider should they wish, however to date Sero are proud to report 100% retention rate.

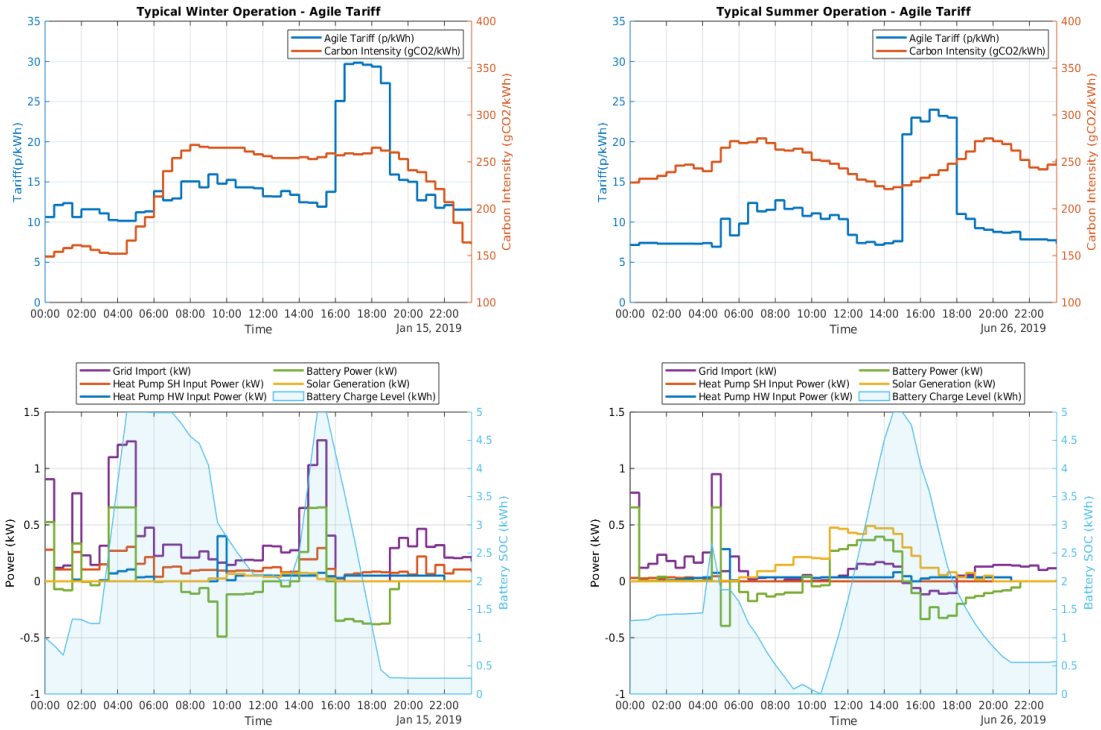
The ability to manage energy consumption allowed the homes to almost completely avoid the National Grid at peak times, keeping carbon intensity to a minimum as well as minimising the cost. With the ability to store energy for future anticipated use, FLATLINE's vision of buying and storing energy at cheaper times plus enabling the benefits of grid balancing payments became a reality.

Below is a snapshot taken during the dDSR trials comparing a Carbon saving tariff against the Octopus Agile tariff. As is evident, the Carbon tariff mainly focussed its electrical import at cheap rate times during the morning, whereas the Agile tariff benefitted from a wider range of cheap rate times. However, both tariffs minimised electrical import during peak rate times.



To achieve these outcomes, project partners Sero and PassivSystems collaborated with Sonnen, Mixergy, Photon, Kensa and Western Power to design and implement a synchronised system. Each element of the smart technology installed within these homes is capable of being individually tracked and monitored to give a granular insight into how each home is performing. This also assists with commissioning and trouble shooting, enabling engineers to pinpoint where an issue may be originating.

Each of these elements feed data to the Building Energy Engine (BEE), the technological heart of the home. This clever box of tricks is made up of numerous components and peripheral devices that meter and monitor the technology. Through such granular insight into the operation of the home, we are able to forecast demand for each home for the entire year, even accounting for seasonal changes.



The above demonstrates typical behaviour during winter and summer when optimised for the Octopus Agile tariff, from which the following can be observed:

Winter:

- The home's battery undergoes a full charge overnight when the Agile tariff is at its cheapest. The heat pump also operates during these cheap overnight tariff intervals.
- The battery then discharges this cheap stored energy during the morning to meet the home's heating and baseload demand, negating the need to draw from the National Grid.
- Prior to the expensive rate energy in the evening, the battery fully charges again when the tariff is cheaper than it has been throughout much the day. The heat pump also runs at high power during this time to prewarm the home.
- The home's heat pump operation is reduced during the expensive evening period. The battery discharges during this period to meet the home's heating and baseload demand. As a result, National Grid import remains at zero during this interval to avoid the need to purchase expensive electricity.

Summer:

- There is no space heating demand during the summer period due to the higher atmospheric temperatures and the home's superior thermal fabric.
- The home's battery charges when the tariff is cheap overnight, but only enough to meet the home's morning demand and until there is sufficient excess solar generation.
- The system recognises that "free" excess solar generation is advantageous over cheap grid import, and thus the battery saves space for upcoming solar.
- The battery then discharges during the morning, before charging from excess solar generation. The battery is fully charged in advance of the expensive evening period, and discharges across this period to avoid the need to import expensive electricity.

This means residents don't need to adjust their living habits or compromise on comfort in order to reduce their carbon footprint. The intuitive technologies built into the fabric of their home anticipates and acts upon the demand of the home as well as a multitude of factors to deliver the residents the lowest cost cleanest energy whilst also supporting the National Grid's decarbonisation.