Active Building Centre

ABC Case Study: Marleigh

Marleigh

Location: Cambridge

Project partners: Hill (builders), Marshalls (landowners) and Pollard Thomas Edwards Architects (designers)

Background

Marleigh is flourishing place with a growing community and high-quality amenities, and this particular project consisted of five Active Homes in Phase 1 of this 1300-home development in Cambridgeshire.

The Active Homes include an integrated solution for:

- **Minimising energy demand** through high-performing building fabric, and heating/hot water and ventilation systems to achieve comfortable internal living spaces.
- **Generating and storing energy** using solar PV, batteries, intelligent hot-water storage and intelligent controls to further reduce demand, running costs and keep carbon emissions low.
- **Charging for electric vehicles** directly linked to the generation and controls reduce costs and carbon emissions from personal vehicle use.
- **Monitoring** energy flows and internal environmental conditions to demonstrate how the homes perform in-use.

ABC provided technical advice and support from concept design stage.

The long-term goal of the monitoring is to provide empirical data on the in-use performance of these privately owned Active Homes and encourage the roll-out of the approach across subsequent phases of the Marleigh development.

Objectives and ABC involvement

As part of acquiring planning permission for the development (RIBA stage 3), one of the planning conditions imposed was for there to be five pilot Active Homes in Phase 1. To discharge this planning condition, ABC and Pollard Thomas Edwards Architects prepared a feasibility study setting out the location, specifications for building fabric and energy systems, and the monitoring approach.

At the pre-feasibility stage, ABC and Pollard Thomas Edwards Architects reviewed the baseline approach to identify options for improving the five pilot Active Homes. The options taken forward formed the basis of the final feasibility study and the approach taken on site.

During the technical design stage (RIBA stage 4), ABC supported the builders and the designers to develop the scope for procuring the MEP (mechanical, electrical and plumbing) consultant and the monitoring solution. As the project progressed into the construction stage (RIBA stage 5), ABC continued their support with the procurement of the integrated energy systems, installation advice for the contractors and guidance for the sales team at Hill.

Solutions

For the five Active Homes, the approaches and technologies explored between ABC and Pollard Thomas Edwards Architects included a full suite of technologies, along with fully certified Passivhaus standard building fabric and Mechanical Ventilation with Heat Recovery (MVHR). The technologies explored included:

- direct mechanical extract ventilation (DMEV)
- solar thermal
- thermal storage
- direct electric heating panels
- Air Source Heat Pump (ASHP)
- solar PV
- PV diverter (into hot water tank)
- EV charging
- Vehicle-to-building energy storage
- integrated controls system and
- building performance evaluation.

Additionally, it was proposed that there are no gas connections across the site and that ASHPs are considered for all buildings (not just non-domestic).

Following feedback and discussions, the fully integrated options taken forward for the five pilot Active Homes by Hill were considered in the context of delivering against the Active Building technical design principles (see Table 1).

Table 1 Rationales for options taken forward

Option taken forward	Rationale
Passivhaus principles for building fabric (instead of full certification)	A fully certified Passivhaus approach was renounced due to concerns about the anticipated additional complexity and costs
MVHR for ventilation and baseload space heating	MVHR in buildings with an airtightness lower than 5 $m^3/h.m^2$ @ 50 Pa provides the higher ventilation rates required in Part F of the Building Regulations. DMEV fans risks potential air quality issues in airtight buildings
ASHP for additional space heating loads and hot water	An active building is off-gas. Additionally, the PV is complimentary to ASHPs
≥ 4 kWp building integrated PV	Solar PV is an integral component of Active buildings. Integrated PV reduces capital costs and looks better. PV is sized according to energy demand predictions and maximum grid connection capacity (single phase)
8 kWh battery	Battery storage is integral to active build-ings. Battery is sized to maximise self-consumption and based on energy demand predictions
EV charging	Future-proofing for forthcoming ban on the sale of internal combustion engine (ICE) vehicles. EVs suitable for V2B energy storage not advanced enough at the time of this development
Integrated controls for PV, battery and EV charging	Integration of active technologies is critical to achieving an active building as they are cen-tral to enabling self-consumption of energy generated on site
Construction, handover and in-use building performance evaluation assessments	To provide insight and learning that can in-form future projects by collecting compre-hensive evidence from delivery through to in-use stages (RIBA stages 5–7). This forms part of the planning condition related to the five active homes
Energy and environmental monitoring (including two further baseline homes)	To provide verification of energy and envi-ronmental performance of the five pilot ac-tive homes and two baseline (non-active) homes. This forms part of the planning con-dition related to the five active homes

Results and benefits

The design stage modelling results predict a 64% reduction in carbon emissions for the Active Homes, compared to if the homes were built to the minimum performance standards set out in Part L of the *Building Regulations* (2013 version).

As well as predictions for reducing demand, increasing generation, and significantly reducing carbon emissions, the Active Homes approach has the potential to realise even greater cost savings compared to the other homes across Phase 1a. These cost savings continue to increase as energy prices rise. The estimated annual cost savings for the Active Homes is based on the residual energy demand being obtained using a Time of Use tariff rate (October 2022). The inclusion of battery storage enables this to be achieved. See Table 2 for energy performance results.

Table 2 Energy performance results in the Active Homes

Parameters	Standard build[1]	Baseline design[2]	Active homes
Average **demand** (kWh/a)	10897	10451	9100
Average **generation** (kWh/a)	Not required	4250[3]	5220
Operational Carbon emissions ($kgCO_2/a$)[4]	1547	880	551
Estimated annual **running cost**	£3705	£2108[5]	£1319[6]

Notes

[1] Standard build = minimum *Building Regulations* (Part L) requirements.

[2] Baseline design = Target performance for the remaining homes in Phase 1a.

[3] Average site generation (PV only being fitted to some homes outside of the five pilot Active Homes).

[4] Based on residual energy demand after renewable energy utilization.

[5] Based on 34p/ kWh (October 2022 price cap).

[6] Based on 34p/ kWh for residual energy demand with 100% utilisation of renewable energy.

To achieve the integrated solution at the five Active Homes, ABC participated in numerous sessions with Hill and their appointed contractors to support the procurement and installation of technologies and systems that were outside their typical supply chain framework and skillsets. This identified several challenges to overcome, as presented in Table 3.

Table 3 Challenges and solutions provided by ABC

Challenges	Solutions
Integration of technologies presented challenges for the contractors	Considerable support was provided to the electrical and plumbing contractors to increase awareness and rationale for integration, and the implications if it not achieved
Limited suppliers of available integrated solutions	Several options were explored, but the lack of opportunity for integration between available products and suppliers was a significant challenge
Integration of energy systems not considered sufficiently at early design stage	The chosen solution consisted of an inverter and EV charger connected as one unit (component). This was a considerable change of approach for Hill and their installers
Integration of monitoring systems, which are not conventional in homes	Considerable support was provided to the electrical contractor to achieve aim and objectives, including an on-site demonstration for installers
Sales team support required	An initial householder guide was produced by ABC to help the sales team with under-standing the nuances of an Active Homes and thus explain and provide answers to potential customers' questions

Lessons learned

Delivering support to the builders and designers of these Active Homes enabled ABC to identify some ways forward for future developments aiming to achieve low and net zero carbon emissions:

1. **Upskilling traditional trades with knowledge and understanding of active technologies** to better facilitate integration of technologies that cross-over other skills areas, for example, electricians and plumbers with renewable energy installers.

2. **Promoting demand for integrated energy and monitoring solutions** to support and give confidence to the supply chain to increase options and availability.

3. **Upskilling key stakeholders** in the Active Building approach involved from concept through to in-use, for example design and sales teams, and occupants.

4. **Further development of the Active Homes Householder Guide** – more detail is required, and this will need to be continuously updated to keep it current as new technologies and solutions come to market.

The outcome from the monitoring and evaluation has the potential to demonstrate the viability and benefits of Active Homes at Marleigh and therefore support this approach to be adopted across future phases of the development. Additionally, capturing the learning from delivering these five pilot Active Homes will support an improved process for all stakeholders going forward.

For further information on the work of ABC, download the **ABC Blueprint - Our approach to net zero**